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EXECUTIVE SUMMARY
RESEARCH AND DEVELOPMENT PRIORITIES SUMMARY REPORT FOR MARCH 1, 1974 TO MARCH 31, 1977

Volume I

Prepared for

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES, Washington, D.C. 20240

by

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Department of Mining,
Petroleum and Geological Engineering
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USBM Contract Final Report

on

Contract No. H0242034

March 15, 1977

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NOTICE

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An overall summary and individual reports from 19 workshops that were conducted to identify and rank mining research and development needs are presented in this two-volume report. At 11 workshops a summary of current Bureau of Mines research and development was presented, and the attendees were asked to present their ideas on which R&D programs should be undertaken to meet their needs locally. Participants included representatives of Federal and State agencies, educational institutions, mining companies, and equipment companies. The workshops covered in this report include lead mining in Missouri; limestone mining, coal mining both surface and underground in the Midwest and the Rocky Mountain area; iron mining in Minnesota; two top management meetings on institutional problems; and finally, a special 2-day meeting on roof control. The need for better education and training of personnel in the industry was emphasized at all workshops. Communication between the mining industry and Federal and State governments needs to be improved. Productivity and the loss of it in the American mining industry represents a tremendous loss to society as a whole in the United States. The U.S. Bureau of Mines is the logical government unit to be an advocate of the mining industry in the United States. Research and development on technical problems such as equipment systems, ventilation, roof control, fire and explosives, blasting, industrial hazards, etc., are all more solvable than the more mundane problems associated with politics and government regulation of the industry.

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FOREWORD

This two volume report was prepared by the Mining Department, University of Missouri-Rolla, Rolla, Missouri 65401, under USBM Contract Number H0242034. The contract was initiated under the Bureau of Mines Mining Program. It was administered under the technical direction of Mining with Mr. L. L. Davis acting as the Technical Project Officer. Mr. R. J. Simonich was the contract administrator for the Bureau of Mines.

This report is a summary of the work recently completed on this contract during the period March 1, 1974 to March 31, 1977. This report was submitted by the author on January 7, 1977.

The author wishes to thank all participants in the workshops for their contributions and time spent in the development of research and development ideas.

EXECUTIVE SUMMARY

INTRODUCTION

Eleven workshops were held in various locations throughout the country in an attempt to reach the many diverse groups working in various mineral commodity areas and specialties. These meetings were held between March 1, 1974 and June 25, 1975. They were held under the auspices of the Bureau of Mines Contract to the University of Missouri-Rolla which was designed to help define Bureau research and development priorities. At each workshop a summary of current Bureau research and development was presented and the attendees were asked to present their ideas on what Research and Development programs should be undertaken to meet their needs locally. Participants included representatives of federal and state agencies, educational institutions, mining companies, equipment companies and other interested parties.

The workshops covered under this report include lead mining in Missouri, limestone mining, coal mining both surface and underground in the midwest and in the Rocky Mountain area, iron mining in Minnesota, two top management meetings on institutional problems and, finally, a special two-day meeting on roof control.

This executive summary reflects the thinking of the author as he was the only person who attended all meetings. Specific recommendations are available to the reader in the attached individual workshop reports. This summary will attempt to reflect the total research and development needs of the mining industry on a broader basis and will not necessarily deal in specifics.

SUMMARY

1. The need for better education and training of personnel in the industry was emphasized at all workshops. The need goes beyond the industry itself in that the general public should be educated to appreciate the role of mining in

the total economy. Social actions by legislative bodies attempting to meet the demands of the public have a dramatic effect upon the economics of mining and the ability of the industry to meet the product demand of our industrial society.

2. Communication between the mining industry and the federal and state governments needs to be improved. This is especially true in the area of regulation of the industry, the formulation of rules and then how these rules are applied. The time has come for a serious review of the many regulations which impact on the mining industry to be reexamined in the light of their true benefits and their impact upon the industry over the past 7 years.

3. Productivity and the loss of it in the American mining industry represents a tremendous loss to society as a whole in the United States. This is especially true in coal where productivity dropped from 16 to 9.5 tons per man shift in the last 7 years. This has necessitated the industry hiring many new workers just to keep total production at the same level and adding otners to meet increased production demands. The introduction of these extra employees into mines has a counter productive effect upon health and safety as a greater number of man hours of exposure takes place to produce each ton of coal. The recognition that good productivity is an excellent health and safety measure should be fully understood.

4. The United States Bureau of Mines is the logical government unit to be an advocate of the mining industry in the United States. This role should be actively pursued in a strong, professional manner and is a point of vital concern to operators in the field.

5. Research and development on technical problems such as equipment, systems, ventilation, roof control, fire and explosives, blasting, industrial hazards, etc. are all important but are much more solvable than the more

mundane problems associated with politics and government regulation of the industry.

6. The role of government and particularly the United States Bureau of Mines, in the research and development programs of the industry, was at no time during these workshops questioned. It appeared to the author that the mining industry, including all of its facets, was ready and willing to cooperate to insure a viable research and development program. While there was some dissatisfaction with the time required to implement research contracts and agreements, the motivation to cooperate was obviously present.

DISCUSSION

This section will discuss research needs, not from the standpoint of a particular mineral commodity, but rather from the standpoint of underground mining needs versus surface mining needs. Obviously some research areas will overlap, but many will be distinct and different.

Needs for Underground and Surface Mining

1. Education and Training of the Work Force is a prime concern. It will affect the health and safety record and also the ability of industry to be productive. Over the period of time that these workshops were conducted, many new training programs have been instituted as a requirement for employment by the mine operators, the union and the Mining Enforcement and Safety Administration. As these programs grow and the labor force becomes trained, problems in this area should become less severe.

2. Governmental Impact in the form of regulations affect both underground and surface mining. In surface mining the largest impact has been in the area of land reclamation while in underground mining it is probably in the area of health and safety. It is important that all regulations have a sound purpose

and are written in such a manner that implementation is possible and reasonable.

3. Both surface and underground have suffered in losses of productivity but the problem has been much more severe to the underground operator. The surface operator tends to solve his problem by using larger and larger equipment while the underground operator cannot take this route, but must be more sophisticated in the use of mechanical mining devices and by maximizing automation.

4. Both surface and underground mining have environmental problems. Surface mining is highly visible and problems here center on land reclamation, revegetation, dust control, blasting noise, etc. Underground mining problems are associated with surface subsidence, ground water pollution or draw-down, acid mine water problems, waste disposal, etc.

5. Both surface and underground mining use many different pieces of mining equipment manufactured by many different manufacturers. There exists, throughout the industry, a lack of standardization of controls on these vehicles. While it would be impossible to standardize all controls, it certainly would be possible to attempt standardization where vehicles perform similar functions and have the same basic movements.

6. There is a need to promote research in the ergonomics area, i.e. man-machine relationships. Greater mechanization can increase productivity and at the same time remove the man from the hazardous area of the mining face.

Surface Mining Research

Reclamation research is obviously a prime consideration but since seven workshops were held on this topic, and it is covered in Volume II, reclamation research will not be discussed in this section. Following is a list of research areas for the Bureau to consider in its program:

1. Slope Stability
2. Drilling and Blasting
3. Maintenance Problems
4. Tires and Industrial Rubber Products
5. Mining Systems and Materials Handling
6. Haul Roads
7. In Pit and Cross Pit Belt Transportation
8. Secondary Breakage Systems
9. Long Distance Transportation Systems
10. Equipment for Spoil Leveling
11. Refuse Disposal
12. Productivity
13. High Voltage Electrical Power Transmission
14. Public Relations
15. Develop Reliable Air Conditioners for Mobile Equipment.

Underground Mining Research

Following is a list of underground research areas for the Bureau's consideration in its program:

1. Noise Control
2. Dust Control
3. Illumination and Lighting Standards
4. Standardized Training for Workmen
5. Communication Systems
6. Public Relations
7. Blasting and Drilling
8. Ventilation - Methane and Dust
9. Materials Handling
10. Mining Systems
11. Rapid Tunneling
12. Roof Control
13. Subsidence
14. Backfilling of Mine Openings
15. Industrial Hazards
16. Resource Recovery
17. Thick Seam Mining Systems
18. Refuse Disposal
19. Ergonomics
20. Incentive Programs
21. Overlap of Regulatory Agencies
22. Women in Mining
23. Roof Bolting Quality Control
24. Function and Mechanism of Roof Bolt Fixtures

CONCLUSIONS

It is the author's hope that these reports have served to fill a need for the Bureau of Mines in aiding it to establish research and development priorities. Readers are referred to the reports on individual workshops where detailed recommendations on research and development projects have been made. The mere fact that these studies were contracted by the Bureau indicates a maturing of the research effort in that it is recognized that there is a need for grassroots input from the industry into the program. As industry sees many of its recommendations implemented, they should become more cooperative and support the Bureau to a greater extent in its research effort. The reader should not misconstrue these statements that the industry does not support the Bureau but, rather, that there is a need for greater communication and dialogue to enable the Bureau to better serve the mining industry, the American miner and, finally, the general public.

LIST OF ATTENDEES

H. H. Vaughn, Chief Chemist, Eveleth Taconite Company

R. J. Matyska, Assistant Chief Engineer, Eveleth Taconite Co.

R. C. Briggs, Liaison Officer, U. S. Bureau of Mines, Minnesota

Galen G. Wadell, Research Director, U. S. Bureau of Mines, Minnesota

Raymond J. Bertie, Assistant Manager, Babbitt Division, Reserve Mining Company

William F. Betzler, Assistant Manager, Jones & Laughlin Steel

R. C. Annear, Superintendent, Inland Steel Mining Company

Albert W. Hagle, Administrative Assistant, Erie Mining Company

Toivo M. Maki, Chief Metallurgist, Erie Mining Company

Oliver W. Borgeson, Chief Engineer, Hibbing Taconite Company

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Ergene L. Palusky, Superintendent, U. S. Steel Corporation

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Bob Rudio, Montana Testing

Joe Duncan, Atlantic Richfield

George Herne, Rocky Mountain Energy Co.

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Tom Parker, Shell Oil-Mining Ventures

Tom Finch, Montana Tech

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Reas R. Madsen, Amax Coal

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Jim Brophy, Jr., Mine Superintendent, The Kemmerere Coal Company

Charles B. Tillson, Jr., Principal Mining Engineer, Kaiser Engineers

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George Oberlick, Atlantic Richfield Co.

Leon J. Mayhew, Rocky Mountain Energy Company

Blake L. Jones, American Coal Company

Clifford E. Oviatt, American Coal Company

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Paul Russell, Research Director, U. S. Bureau of Mines, Colorado

Tom Morgan, Research Engineer, U. S. Bureau of Mines, Colorado

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Don Huckeby, Manager of Engineering, Arch Mineral Corp.

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Robert R. Voss, Safety Director, St. Joe Minerals Corporation

R. L. Bullock, Director of Mining Research, St. Joe Minerals Corporation

Milton F. Bradley, Senior Mine Engineer, Cominco American Incorporated

A. F. Rambosch, Mine-Mill Manager, Amax Lead Co. of Missouri

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USBM Contract No. H0242034

RESEARCH AND DEVELOPMENT PRIORITIES
IRON MINING IN MINNESOTA

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June 25, 1975

Prepared for the U.S. Department of the Interior
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NOTICE

Ths views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or of the U.S. Government.

INTRODUCTION

This report is the 11th of a series reporting findings from workshops held with various segments of the mining industry under U.S. Bureau of Mines Contract No. H0242034. This meeting was held in Hibbing, Minnesota on June 25 at the Kahler Motel. Mr. Ron Briggs, State Liaison officer, U.S.B.M. and Galen Waddell, Research Director, Twin Cities Mining Research Center, were most helpful in setting up this meeting. Nine iron mining companies were represented. Bureau representatives were present to assist in taking notes and as observers. Mr. Waddell made an informal presentation on the restructuring of the Twin Cities Mining Research Center to better meet the needs of the industry. Mr. Briggs discussed his role as a State Liaison Officer. Both Bureau representatives stressed the role of the Bureau as a helpmate to industry in solving technical problems.

The morning portion of this meeting was devoted to problem definition and the afternoon was spent on setting research priorities. It became evident that some of the problems of the iron mining industry are more of a metallurgical nature than of mining and these are included as a separate item in this report to be considered by the Assistant Director for Metallurgy.

RATING OF PROJECTS

Projects were broken into six different areas plus a section on metallurgical problems. Each area had several sub-categories. They are included in the following list:

1. Energy
    - 1.1 Pelletizing
    - 1.2 Equipment
    - 1.3 Power Generation

2. Safety and Health
    2.1 Health
        2.1.1 Personal Protection In-Plant and on Rolling Stock
        2.1.2 Asbestiform Particles
        2.1.3 Alcohol and Drugs
        2.1.4 Dust

3. Equipment
    3.1 Hydraulics
    3.2 Visibility
    3.3 Automation
    3.4 Remote Control
    3.5 Standardized Controls

4. Communications
    4.1 Standards
    4.2 Interpretations
    4.3 USBM Focal Point for Government Contracts
    4.4 Reporting Procedures and Reports
    4.5 Bureau to Serve as A Research Clearing House

5. Education and Training
    5.1 Motivation
    5.2 Manpower Shortage-Crafts-Electricians
    5.3 Vocational Training
    5.4 Women in Mining

6. Technical Areas - Mining
    6.1 Maintenance
    6.2 Drilling and Blasting
    6.3 Slope Stability
    6.4 Dust Control - Plant, Pit & Transit
    6.5 Tires & Industrial Rubber Products
    6.6 Underground Feasibility Studies
    6.7 Secondary Breakage
    6.8 Mining Systems & Materials Handling
    6.9 Drainage
    6.10 Metric System Applied to Mining

7. Metallurgical Research Areas
    7.1 Improved Alloys
    7.2 Mineralogy Studies
    7.3 On-Line Analysis for Plant Control
    7.4 Bentonite
    7.5 Refractory Ores - Low Grade, Semi and Non-Magnetic Taconites

A short discussion will be given on each of the areas to reflect the discussion at this workshop. Attendees have been asked to submit letters reflecting their opinions as to the most significant points covered.

DISCUSSION

The author opened this workshop by presenting an overview on the role of the Bureau of Mines in developing a strong research program to assist the industry in meeting the challenges of the future. Numerous handouts were circulated including the latest Technology Research pamphlet put out by the Bureau. The attendees at this workshop seemed to have less knowledge of the Government's role in research than have persons in past workshops involving coal. This probably reflects the fact that several times as much effort has been put forth in coal as has been done on metal and non-metal mining. It was emphasized to the attendees that the R&D workshops serve as an undiluted input which can be made by the industry directly to the Bureau of Mines.

Following is a discussion of the previously listed projects. The discussion will not necessarily follow the chronological order of the workshop as many subjects were discussed more than once during the day.

1. Energy

1.1 Pelletizing: The pelletizing process is one which uses a great deal of energy which, historically, has been in the form of oil and natural gas. Industry representatives recognized that these supplies are becoming scarcer and that there is a need to consider other energy forms and, in this case, the one most logical seems to be coal. While some companies are experimenting on their own with coal as a fuel, it does seem that some effort by Government in this area is warranted. This might have to be handled under ERDA.

1.2 Equipment - Erie Mining Company uses shaft furnaces while other companies use some form of traveling grate in the process of hardening pellets. For this reason, research would have to be done on both types of equipment to ensure that changes to coal would be possible.

1.3 Power Generation - Some of the companies present generate their own power in gas turbines. If gas were not available, conversion to coal would seem to be the only viable recourse and research on the ramifications of such a move and how it could be carried out need to be investigated.

2. Safety and Health

2.1 Noise - This subject was actively discussed throughout the course of the meeting. It is obvious that the industry representatives fear what may be coming in the future and expressed great concern for the fact that they could not, in many cases, presently meet the 90 dba standards set for maximum noise level. The biggest problem area seemed to be in plant operation, particularly in the proximity of rod mills. It was pointed out that sources of noise were not adequately understood and that building design sometimes tend to amplify noise, making the problem more serious. An example was, in one building where a steel staircase constantly vibrated when the mills were in operation.

Attendees also discussed the noise problem in relation to rolling stock but it was felt the problems here were less severe. In the case of the man, there was a feeling that workers should be required to wear personal safety equipment where no viable technical solution to the noise exists. It was felt that there was need for a standard which would penalize the worker if he did not follow orders and wear the equipment provided by Management. It was recognized by the attendees that this would be a very difficult standard for the Federal Government to promulgate.

2.2 Health

2.2.1 Personal Protection in Plant and on Rolling Stock -

While some forms of personal protection, such as safety shoes, safety glasses and hardhats have been accepted quite universally by union employees, other forms of personal equipment such as ear plugs, dust respirators, special breathing apparatus and clothing are not necessarily accepted. There needs to be research to make these devices as comfortable as possible and ways should be investigated to motivate the workmen to wear them continuously.

2.2.2 **Asbestoform Particles:** There has been a great deal of publicity in the Minnesota area in regard to fiber-like particles, somewhat resembling asbestos, in the streams and lakes of the area. The attendees felt that research needs to be done to determine what has been the natural background level of these fiber forms and just how much industry has contributed to the problem if, indeed, it is a problem.

2.2.3 Alcohol and Drugs: Alcohol has been an age-old problem for mine management to cope with and runs the gamut of workers from young to old. Recently a new problem of drug usage, principally by the younger members of the work force, has become a severe enough problem to cause the companies grave concern. Workmen operating such things as trucks, capable of carrying in excess of 100 tons of material need to have their wits about them at all times or they represent a tremendous safety hazard to all employees. Several examples of unexplained truck accidents were cited to support this contention. Research is needed on methods to determine a man's capability of handling his job before he goes on shift.

2.2.4 Dust: There was not great concern for the health hazard of dust as long as the operators wore protective devices management provides. Research was recommended into sources of dust and collection systems which might be employed.

3. Equipment

3.1 Hydraulics: Due to the high pressure being employed in hydraulic systems, there is need for research on seals and "o" rings, better able to withstand this pressure. Equipment reliability in this area can be enhanced if preventive maintenance can be improved and if equipment can be better designed initially. There is a need for better trained personnel to cope with these problems.

3.2 Visibility: It was recognized by the attendees that as equipment becomes larger and larger, there is a decrease in visibility in and around the vehicle. A special study in this area would seem warranted.

3.3 Automation: Since capital costs are so high on equipment, there is a need to use it as efficiently as possible. Whereever possible, automation should be employed to eliminate operator fatigue and to improve overall efficiency. Research is recommended.

3.4 Remote Control: Remote control can be used to remove the operator from certain hazardous areas, particularly where noise and dust levels are high and, at the same time, may be employed to allow the operator better visibility in his job.

3.5 Standardized Controls: It was felt that there is a need to standardize controls, where possible, on trucks, front end loaders and shovels, to prevent accidents when an operator moves from one manufacturer's vehicle to another.

4. Communications

4.1 Standards: It was felt that there is a lack of communications in the development of new standards and in their promulgation. There is not enough communication between industry and Government in this topic area. Industry representatives felt they had probably been remiss in their own efforts to communicate, but expressed a desire to improve that situation. The attendees felt it was particularly difficult to communicate with the vast number of agencies. Research is needed to eliminate bureaucratic red tape and overlap.

4.2 Interpretations: Lack of standard interpretations by various inspectors and agencies is a constant problem for the industry. "What was good enough last week is not always good enough now". The goals of standards should be researched to better define them and then to better implement them.

4.3 USBM as a Focal Point for Government Contact: It was felt by the attendees that if the U.S. Bureau of Mines could be the principal agency dealing with the mineral industry, some of their problems might disappear. It was pointed out that other agencies do not have trained mining personnel and, therefore, are not technically capable of making intelligent decisions. The industry is constantly burdened with educating inspectors to the real life situation of mining and results in consequent aggravation and hardship to the industry.

4.4 Reporting Procedures and Reports: Research is needed to develop one report which the industry could submit which would meet the needs for information for the numerous agencies with which it deals. Large staffs of people are maintained at present to meet the reporting requirements of government. If research could be done to streamline this process, it would be of immense aid.

4.5 Bureau to Serve as Research Clearing House: The attendees felt, perhaps as a result of the author's presentation on the Bureau's programs, that the Bureau should do a better job of informing them of the research efforts and make it easier for them to get information needed. It was pointed out to them that programs to fill their needs are presently available and it was suggested they get on the Bureau of Mines' mailing list for publications. It was suggested that the Bureau develop a library information system from which industry could get reference lists on any topic that they felt was a problem for them. If the Bureau could perhaps computerize this system, it would be possible for industry to get a quick and accurate response to their inquiries.

5. Education and Training

5.1 Motivation: Attendees felt the workman of today is not normally heavily motivated in his job. Research needs to be done to find out what "turns him on" and to develop ways to develop worker productivity.

5.2 Manpower Shortage - Crafts - Electricians: Three of the companies at this meeting have major expansion plans which will create at least 2,000 new mining jobs in Minnesota. There will, of course, be other jobs generated by the people employed in support services. It was felt that over the long haul most of these jobs could be filled without too much difficulty, except in the area of craft labor. A particular shortage was pointed out for electricians. Research is recommended to determine how this labor shortage might be solved.

5.3 Vocational Training: It was felt there was need for a greater degree of vocational training to meet the needs of the industry. Hibbing, Minnesota is blessed with a vocational school as well as a Junior college and, perhaps, with proper encouragement, their needs can be met.

Again, research is recommended.

5.4 Women in Mining: It was pointed out by several of the companies that they employ women at the present time and, for the most part, are satisfied with their performance and ability to their jobs. Upon initial employment, they are highly motivated and seem to be actively trying to prove their worth. After working for a period of one or two years, a considerable amount of this initial ambition seems to be lost and they fall into the pattern of the total work force.

6. Technical Areas - Mining

6.1 Maintenance: As in the case of the surface coal mining workshop, this workshop also felt that maintenance of the large equipment associated with surface mining is a major problem to them. Downtime costs are so severe that a great deal of time and effort have to be spent on preventive maintenance and developing strong machine reliability. A constant program of research into this problem is recommended.

6.2 Drilling and Blasting: While much work has been done in the iron ranges on drilling techniques, it was felt that further work could be done. Interest was indicated in a rotary bit which would have the capability of chambering the bottom of the hole. An air piercer as a substitute for jet piercer was also discussed. Obviously, ways to increase rates of penetration is of interest. In a blasting area, most of the discussion centered upon how to prevent difficulties with the neighbors from the standpoint of blast noise and blast damage. The major companies already have consulting firms under retainer which assist them in selecting the best times for blasting, i.e., when conditions are such that there is the least chance for complaints. Blast sizes vary from 300 to 800,000 tons of crude ore per blast and may involve as much as 500,000 lbs. of slurry. The companies were particularly interested in low frequency vibration. They did, in their discussion,refer to TPR 78 of the U.S.B.M. as a research effort which has helped in their problems. They did recommend that more research be done.

It was pointed out by Galen Waddell that the Bureau of Mines desires to work cooperatively with the industry but that they should realize that research, in some cases, could possibly hurt them when lawsuits are involved. It seemed to be a concensus that if research were done in areas more remote from neighbors, there would be a lesser chance of difficulties developing between the Bureau and industry in the sensitive area of dealing with their neighbors.

6.3 Slope Stability: At the present time, slope stability is not a major concern for iron mining companies in Minnesota, but as pits become deeper, it can become an an important consideration. Therefore, some research work in this area is recommended.

6.4 Dust Control - Plant, Pit and Transit: Due to the cold climate of Minnesota, dust control can be difficult when water cannot be used. Research was recommended to find some substitute for water in dust control. Also, a treatment which might be placed upon pellets was of interest to eliminate dust in the total transportation cycle from the mine plant to railroads, ships, rail and into blast furnaces.

6.5 Tires and Industrial Rubber Products: Research is constantly needed to improve tire life, as it represents almost 1/3 of the operating cost of most heavy rubber-tired mining vehicles. Another problem is "how can the old tires that are worn out be put to some use?" There are vast piles of these tires on mining ranges which could possibly have considerable value.

6.6 Underground Feasibility Studies: It was pointed out that iron mineralization goes to great depths in Minnesota and some long range underground mining feasibility studies were recommended. These might be similar to the studies conducted by the University of Minnesota some years ago.

6.7 Secondary Breakage: There is a need for research to improve secondary breakage in the pit and also at the dump points in the crusher. Taconite boulders, if they do develop, are extremely hard and more efficient ways of breaking them other than drilling and blasting are needed. Electrofracing was mentioned as a possibility as well as large hydraulic breakers.

6.8 Mining Systems and Materials Handling: There was some interest expressed in new excavation systems using wheel excavators in conjunction with conveyor belt systems. Automated truck systems were also discussed. These would be systems which would have no operator in the truck during the period of time it moves on the main travel road from the shovel to the crusher. While this research might be considered "blue sky" and long range, it was recommended.

6.9 Drainage: Due to the large size and lateral area encompassed by the pits in Minnesota, numerous sumps and pumps are normally used in dewatering. At present, it is difficult for the operator to keep this system under control and to properly monitor all the discharges. Figures are often required by governmental control groups which are difficult to ascertain. Research on the problem is recommended.

6.10 Metric System Applied to Mining: It was pointed out by one of the conferees that it will be an extremely difficult problem particularly in the land description and lease area if the metric system is adopted in the United States. Research needs to be done to develop the best method for the industry to cope with this problem.

7. Metallurgical Research Areas

7.1 Improved Alloys: Conferees recognized that research is probably going on in this area, but due to the extreme abrasiveness and high wear characteristics of taconite, further research is recommended to develop harder, more wear resistant alloys.

7.2 Mineralogical Studies: It was pointed out that the pellet plant operators do not really know why some iron minerals pelletize well while others present difficulty. It is supposed that subtle mineralogical changes have an effect upon this process but, due to the complexity of ores and the many variables, the effect of mineralogical change are not fully understood. Research is recommended.

7.3 On-Line Analysis for Plant Control: Due to the size of the plants on the iron range, any imbalance within the flow system can have disastrous results. Operators are very interested in getting reliable, dependable on-line analysis systems developed to a point where they can depend upon them rather than on operator judgment.

7.4 Bentonite: Operators have experienced difficulty in obtaining bentonite and the price seems to be rising fast. Questions were raised as to just what constitutes a good bentonite for the pelletizing process and are there any other materials which might be employed which could the job as well and be more readily available. Therefore, research is recommended into binding agents for the pelletizing process.

7.4 Refractory Ores-Low Grade and Semi and Non-Magnetic Taconites: There are vast quantities of materials on the Minnesota iron ranges which contain varying percentages of iron. It would seem in the National interest to continue research into ways these iron units might be recovered. Much of this material has already been blasted and moved into piles or into tailings basins, so the mining of them is not the problem but rather the treatment is. It could conceivably be possible to recover these iron units through some chemical leaching process.

CONCLUSIONS

This workshop contrasts with others conducted by the author in the coal industry in that there was a great deal less concern expressed toward the role of government in regulation in the direct operations of the mines. This is perhaps true because most companies are owned by mature steel industries and have well organized staffs and normally an adequate supply of technical talent to solve many of their problems. The author felt there was a feeling that if the government were completely out of the role of regulation of the industry that the industry would do as good as is presently being done. Regardless, the attendees welcomed the opportunity to communicate with government and I feel they appreciated the interest in the Bureau of Mines in sponsoring this workshop in which they were able to air some of their problems.

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USBM Contract No. H0242034

RESEARCH AND DEVELOPMENT PRIORITIES
SURFACE COAL MINING IN GREAT PLAINS AREA

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NOTICE

The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or of the U.S. Government.

INTRODUCTION

This report is the 10th of a series reporting findings from workshops held with various segments of the mining industry under U.S. Bureau of Mines Contract #H0242034. This meeting was held in Billings, Montana on June 19, at the Ramada Inn. Mr. George Krempasky, State Liaison Officer, Montana, for the U.S. Bureau of Mines, was most helpful in assisting the author in setting up this meeting. Seven coal companies, a consultant and a faculty member from Montana Tech. were represented at this meeting. All participants were very frank and vocal in their suggestions as to the true problems of the western surface coal industry. George Krempasky assisted in taking notes and answered several questions relative to State and Federal objectives in the development of western coal.

A rigid set of priorities was not developed at this meeting and the ranking of projects is that of the author. One factor stood out above all others and that is that political problems completely override all aspects in regard to technical development in the exploitation of western coal reserves.

GENERAL RATING OF PROJECTS

Two broad areas of individual projects developed within the framework of this workshop. They were:

I. Political Problems

II. Technical Problems of Mining

The author has broken down these broad areas of the individual projects as follows:

1. Political

    1.1 Uncertainty of the future of the coal industry
    1.2 Short term mining permits (1 year)
    1.3 Montana's plan 30% tax on coal
    1.4 Overlap of agencies, both Federal and State
    1.5 Impact on communities by mining operations
    1.6 Pessimism of industry for the future-things are getting worse

2. Mining Technology

    2.1 Education and training
    2.2 An imbalance in operating cost
    2.3 Unrealistic standard
    2.4 Specific technical problems

A short discussion will be given on each of the areas which the author hopes will reflect the discussion at this workshop. Attendees have been asked to submit letters reflecting their opinions as to the most significant points covered.

DISCUSSION

The author opened this workshop by presenting an overview on the role of the Bureau of Mines in developing a strong research program to assist the industry in meeting the challenges of the future. Numerous handouts were circulated including the latest Mining Technology Research pamphlet put out recently bh the Bureau. The magnitude of the program was discussed and its possible impact upon the coal mining industry of the Western United States. It was emphasized that the R&D workshops serve as an undiluted input which can be made by industry directly to the Bureau of Mines and, for this reason, it was hoped that the industry representatives would put considerable thought into their recommendations.

Following is the discussion of the previously listed projects. The discussion will not necessarily follow the chronological order of the workshop as many subjects were discussed more than once during the course of the day.

1. Political Problems

1.1 Uncertainty of The Future: There was no question but that the actions of the Western State governments, particularly Montana, and the Federal Government actions, completely override all technical mining decisions and rational development of coal deposits in the Great Plains area. This is exemplified by the fact that coal companies are not able to put together viable mining blocks of coal in a contiguous manner where private and federal lands join. Specific examples were given by the attendees where coal reserves on Federal lands would be bypassed as they mined private lease holdings, making the coal on the Federal areas unmineable in the future. This represents a substantial loss of coal resources for the Nation.

The State of Montana and the Indian Tribal Councils on reservations are constantly changing the rules for operation of mining in their respective areas. Some means must be developed to change this situation or new projects will not be undertaken due to their high capital risk. The attendees were posed the question: "Can the United States reach its goal of Project Independence of 1.2 billion tons of coal production by 1985?" The highest estimate that was presented was a production of 800,000 tons as of that date if the political climate stays as it now is in the west. They felt large advances in production were possible within the confines of present reclamation and regulatory practices as long as these practices were not constantly changed.

1.2 Mining Permits: The problem of State mining permits in Montana was discussed at length. Requests for mining new acreage and continuation of mining on present acreage is reviewed yearly. There are substantial financial penalties if certain deadlines are not met in the request for continuation and the application for new mining areas. This presents an extremely difficult situation for mining companies to face and requires them to constantly send people to Helena to meet with State agencies in an effort to maintain permission for continuous mining. Several man years are spent by each company each year in meeting this unrealistic requirement.

1.3 Montana's Planned 30% Tax on Coal: The attendees felt that this tax was conceived and being pushed through the legislature, not as a justifiable tax on mining but rather as a tax to prohibit mining in Montana. They also felt that it put the operators of Montana at an unfair disadvantage at the marketplace with operations in Wyoming which operate at only a 6% tax. It was felt that there was a need for research into the priorities of the states of the west and the Federal government. In this case where energy is needed to meet national needs, a question arises as to whether or not State rights override this critical national need for energy.

1.4 Overlap of Agencies-Federal and State: There was much discussion on the qualifications of many State inspectors. It was pointed out that they are not paid well and few have any technical background for the jobs in which they have been placed. They seem to be more interested in finding ways to harrass the companies than they are in assisting the companies to operate in a logical manner which meets regulations. There was some discussion of Federal inspectors, particularly from MESA but it was felt that, on the whole, these inspectors were better trained and more qualified for the jobs.

In the Federal area, it was pointed out that there seems to be a great deal of overlap in the U.S.G.S. and the Bureau of Land Management in their roles of regulating mining. It would seem that, since both agencies are under the Department of Interior that their jurisdictional areas could be clarified to prevent conflicts.

1.5 Impact of Mining Operations on Communities: It was felt that the Bureau could play a lead role in studying the effects of mining upon remote small communities in the west where sizeable operations are contemplated or already in existence. It was recognized that mining companies do have a responsibility to the community and that everything possible should be done to minimize effects upon housing, public services, schools, etc. It was felt that the public relations efforts by the industry have been ineffective in many instances and that a broader program of education as to the benefits of mining to the community would be most helpful.

The author did travel through Gillette, Wyoming and visited AMAX's Bel-Ayre mine and saw firsthand the obvious rapid growth of that community. The numerous mobile homes, in many cases, situated on tracts of land in such a manner that they appeared to be jammed together which were obviously not well planned housing development and were testimony to the seriousness of this problem. It is the author's opinion that some of this problem will be eliminated in the future as mines get into production and the great number of employees of construction companies then leave the area. Large surface mines do not employ great numbers of people. The Bel-Ayre mine, at present, employs only 85. This factor should be taken into consideration in community planning.

1.6 Pessimism of the Industry for the Future -"Things are Getting Worse": Mining operators are, by nature, optimistic or they would never have entered the high risk industry in which they are involved. It was disheartening for the author to hear the pessimism which was expressed in this meeting for the future of western mining , if a radical change in political attitudes does not evolve. There was agreement that the industry could meet the challenges of the technical problems of equipment, mining, reclamation, etc., if only the ever-increasing proliferation of obstacles of a political nature with which they are confronted could, in some manner, be removed. It was felt that if there was not a national crisis there would be little chance that major changes would be made which would enable the industry to move forward in a logical, workmanlike way.

2. Technology

2.1 Education and Training: Due to the lack of people in the west and the fact that many mining operations will be on Indian reservations, the training and educating of workers is a major problem. This is particularly true of training electricians and mechanics. The Indians and ranch hands already know how to drive trucks and can be trained in a relatively short time to operate shovels. The maintenance of these sophisticated pieces of equipment is another problem. There is a problem that the union scale is not sufficiently different from the mechanic, electrician and truck driver level to interest workmen in training themselves for these positions. It was pointed out that local schools need assistance in their vocational training programs to assist in the education process to develop these special skills.

The education and training effort should carry over into the inspectors, as they are obviously not trained adequately. It might be possible for cooperative programs to be set up in cooperation with schools such as Montana Tech to assist in training these people.

2.2 An Imbalance in Operating Costs: The author was shocked to learn that, on the average, the actual cost of mining is only 20% to 25% of the total cost in running a western surface operation. This figure means that there are obviously external forces operating upon these mines which are draining the financial base of the operation to an extent completely beyond reason. A study by the Bureau is recommended to determine just what these costs are and how remedial action might be taken to relieve mining companies of some of this burden.

2.3 Unrealistic Standards: The attendees felt it was time for a complete review of the Coal Mine Health and Safety Act to re-evaluate the standards which have developed over the past five years. It was felt that many of the standards for surface operations were developed with contour mining and eastern strip mining in mind and they sometimes work to the detriment of western thick seam mining operations. Too often, a standard has been promulgated and, over a period of time, the original goal of the standard is lost but continues to be enforced with little benefit to the worker or the industry. To be effective, a research project on standards should investigate all standards and not just a select few.

2.4 Specific Technical Problems: The author emphasizes that technical problems in western surface mining are completely subordinate to all the aforementioned problem areas. Attendees felt some work was warranted but they also felt if the previously mentioned problems were eliminated, they had the capability of meeting and solving technical difficulties.

2.4.1 Dust: Research is recommended on the source of dust, the control methods, and particularly how stockpile dust can be controlled.

2.4.2 Noise: There is a need for equipment manufacturers to to design their equipment to operate at lower noise levels and to build into that design,noise protection for operators.

2.4.3 Drying and Preparation: There is a need for some work on ways to remove moisture from western coal, as transportation is such a large part of the total cost to the consumer. Also, it was felt that while most operations do not anticipate preparation plants, there is a need for research into the removal of undesirable constituants at the mine site.

2.4.4 Continuous Haulage System: It is recommended that research into the use of belt, slurry and other continuous transportation methods be undertaken by the Bureau. Many of the deposits in the west resemble, in many ways, the Brown coal deposits of Germany and perhaps some of the techniques employed there could well be adapted to western mining. While wheel excavators are being tried with modest success, it is recommended that more work be done on their application and utilization.

2.4.5 Demonstration Projects: It was recommended that the Bureau expand a great deal of effort in demonstration projects which would be used to develop new mining systems and serve as a breeding ground for new concepts and ideas which might be applied in the uniquely different deposits of the west. Due to the size and scope of such demonstrations, it is recommended that the industry play a strong role in deciding which projects should be funded and that industry cooperate fully in the execution of such projects as an equal partner with the government.

2.4.6 Reclamation Studies: There is a need for materials handling studies in regard to reclamation as to the normal losses which result in removing top soil and then replacing it on top of the reclaimed soil. It was pointed out during the meeting that some state regulations are so stringent that it is impossible to meet them when these normal losses are not taken into consideration. Also, the interrelationship between soil removal, storage, replacement and the equipment which the industry has available to it to accomplish this should be studied.

2.4.7 Equipment Reliability: It was felt that not enough research has been done on developing mining equipment which will be reliable in the real life operations must face during mining. Too often, equipment manufacturers are lax in developing rugged equipment which meets the rigors of the mining operations, and a great deal of effort must be expended by the mining operators to beef up and rebuild essentially new equipment.

2.4.8 Support for Small Equipment Manufacturers: It was felt by the attendees that many good ideas have fallen by the wayside due to the fact they have been conceived by small equipment manufacturers with limited financial resources to develop their thinking. It would seem to be a logical role for the Bureau to expend funds to assist these manufacturers and thereby use their original thinking in the enhancement of mining technology. It is important that a patent policy be developed which will allow the small operator some financial reward from his idea. Without that enticement, there would be little hope of these people cooperating with the government in a program.

2.4.9 Remote Mining and Automation: Due to the thickness and vastness of western coal deposits, it was felt that some work should go on for automating mining process and developing remote mechanical methods for removing coal from say short surface boreholes by some type of hydraulic jet or some other system of mechanical removal. Automation of equipment in the normal surface operation was also discussed and it was felt that due to the enormous capital investment on shovels draglines, trucks, etc., that some degree of automation would be helpful to the individual operator in improving his efficiency.

2.4.10 Slope Stability: It is recognized that in the future, western coal mines will proceed to some depth and that slope stability will be a major economic consideration to the operator. For this reason, research was recommended in this area.

2.4.11 Publication of Information by the Bureau of Mines: It was felt the Bureau of Mines should be a clearing house for mining information and that the process of publication should be reviewed to assure that it is timely, pertinent and that it gets into the hands of the operators quickly so that it can be applied to the industry.

CONCLUSIONS

The author realizes that the Bureau of Mines is essentially a professional mining research organization which should stay out of the political arena, but my major conclusion from this workshop is that without a resolution of the political problem associated with western mining, little can be done of a technical nature which will allow any substantial increase in production.

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USBM Contract No. H0242034

RESEARCH AND DEVELOPMENT PRIORITIES
UNDERGROUND COAL MINING IN WESTERN U.S.A.

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NOTICE

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INTRODUCTION

This report is the ninth of a series reporting findings from workshops held with various segments of the mining industry under U.S.B.M. Contract No. H0242034. This meeting was held in Denver, Colorado on June 10 at the Petroleum Club. Mr. Joe Smith, State Liaison Officer, U.S.B.M., Mr. Tom Morgan, Research Engineer, and Mr. Bucky Wisecarver, Research Engineer, were most helpful in assisting in setting up this meeting. Eight coal companies and an equipment company were represented. These company representatives are to be commended for the time and energy they devoted and for their forthright appraisal of research and development projects which should be considered for the western underground coal industry. Bureau representatives were present to assist in taking notes and as observers. They did answer a few questions relative to Bureau programs but, essentially, the information presented in this report was supplied directly by industry representatives.

There was not time at the meeting to develop rigid priority numbers to go along with research projects recommended. Therefore, the ranking in order on research projects is one that has been established by the author and may or may not reflect the true thinking of the attendees. Of course, all projects mentioned were discussed and did receive considerable attention.

GENERAL RATING OF PROJECTS

Two broad areas for grouping individual projects seemed to develop within the framework of this workshop. They were:

1) Productivity Research

2) Research to Develop Mining Technology

While both of these areas are naturally closely interrelated, the author has tried to break down the individual projects so that they fall into these two general areas.

1. Productivity
    - 1.1 Human Problems
    - 1.2 Methods and Systems
    - 1.3 Communications
    - 1.4 Maintenance
    - 1.5 Education and Training
    - 1.6 Employer-Employee Relations
2. Technology
    - 2.1 The use of USBM as a clearing house for information on problem solving
    - 2.2 Dust
    - 2.3 Noise
    - 2.4 Lighting
    - 2.5 Roof Control
    - 2.6 Equipment Design
    - 2.7 Resource Recovery
    - 2.8 Ventilation
    - 2.9 Long Distance Transportation
    - 2.10 Thick Seam Mining Systems
    - 2.11 Subsidence
    - 2.12 Refuse Disposal

A short discussion will be given on each of these areas which the author hopes will reflect the discussion at this workshop. Attendees have been asked to submit letters reflecting their opinions as to the most significant points covered.

DISCUSSION

The author opened this workshop by presenting an overview of the role of the Bureau of Mines in developing a strong research program to assist the industry in meeting the challenges of the future. Numerous handouts were circulated including the latest mining technology research pamphlet put out recently by the Bureau. The magnitude of the program was discussed and its possible impact upon the coal mining industry of the Western United States. It was emphasized that the R&D workshops serve as an undiluted input which can be made by industry directly to the Bureau of Mines and, for this reason, it was hoped that the industry representatives would put considerable thought to their recommendations.

Following is the discussion of the previously listed projects. The discussion will not necessarily follow the chronological order of the workshop as many subjects were discussed more than once during the course of the day.

1. Productivity

1.1 Human Problems: There was complete agreement that the biggest single problem of the coal industry of the west was to deal with human problems. These problems seem to affect everyone from the man on the street,to the child in the school, environmentalists, the local businessman, the housewife, as well as the workers in the mines. In essence, the mining industry has a poor public image and this detracts from mine productivity in the form of delaying actions which prevent the opening of new mines. The difficulty of obtaining mining permits from the government on its lands, the proliferation of Government reports before and after mining starts, the difficulty in attracting intelligent, young people into the industry, etc., are all major problems. It seems that the importance of the production of coal has been lost in the maze of human problems surrounding the industry. Specific research problems include motivational studies: "How Can Mine Environment be Improved"; "How Can Unions be Moved to Accept Responsibility for Their Members' Actions (Wildcat Strikes)"; "How Can The

Public Image be Improved"; "How Can The Government be Moved to Reach Decisions Quickly which Affect The Mineral Industry"; etc.

1.2 Methods and Systems: The need for new approaches for mining thick seam deposits in the west was emphasized. These seams should be highly productive, but at the present time, there is no system which could be universally applied to develop the anticipated high production. Due to the high cost of research on new mining systems, it was felt that the government should play a large role in venturing into the unknown in this area. Since many of the coal deposits are on government land, the government and the taxpayers will be one of the chief beneficiaries of this research. Specific research areas mentioned include longwall support for seams in excess of 30 feet thick, equipment designed for seams that vary radically in thickness (from 6' up to 30'-Kaparowitz Plateau), ventilation problems in thick, high seams, subsidence studies, ground control studies for high backs and high pillars, hazard detection and the prevention of coal bumps, longwall versus shortall mining concepts, and the application of new power systems underground, principally diesel.

1.3 Communication: It was felt that there was a great need for the communication of new ideas to the industry so that it is not necessary for the industry to continue to "reinvent the wheel". As in Item No. 1 in the Technology Section, it was felt that the Bureau of Mines should serve as a center of communications for the mining industry in developing new operating ideas, systems and techniques.

Another aspect of communication between management and union personnel involves the rudimentary jobs of getting productivity from the mines. Too often, instructions are misinterpreted and needless delays and losses then occur. The work of the Mine Communications group of the Bureau was applauded as one which allowed closer communications to the worker in the mine and thus eliminated many problems. The Bureau of Mines Technology Transfer program was supported as a step in the right direction but it is a program that needs to be expanded to include operating ideas as well as advances in mining technology. It was pointed out that MESA should cooperate by providing input to the Bureau when it feels that a particular mine or segment of the industry has developed an operating procedure which would be beneficial to all industry.

1.4 Maintenance: Productivity is only possible with a strong preventive maintenance program. The attendees felt that more research needs to be done in this area to assure that equipment is operational and continues to be so through the entire shift. It was pointed out that many maintenance problems are directly tied to the problems of safety and permissibility of equipment. A very minor permissibility violation can put an otherwise productive piece of mining equipment out of business. Research into how to keep equipment operating is needed. Also, a review of the factors which should cause a machine to shut down due to malfunctioning of these devices and, at some point, the whole safety program becomes counterproductive and well intended safety controls will, in essence, make the whole operation non-productive and uneconomic.

1.5 Education and Training: A great deal of time was spent on the problems of education and training. There was a strong sentiment expressed by several of the attendees that the industry had the prime responsibility in this area and could probably do a better job than the government in devising and implementing education and training programs. Generally, the attendees approved of the government's work in education and training but, in some cases, it was felt the government's programs were oversold, too long and not really structured to acquaint the man with the problem and then educating in its solution. An example was: The program put on by the government for use of the self-rescurer which called for a 30-minute course when it was felt that 10 minutes was more than sufficient time to instruct the man in the use of the rescurer. There was considerable discussion as to the attitude of miners in regard to dust samplers which are often "dumped" to void the sample by the man so that it becomes very difficult to get an accurate measure of dust, even though this program was conceived and developed to protect the miner wearing the sampler.

Several educational programs were cited as being excellent training for miners and technicians. They included high school programs in hydraulics, mechanics, and electrical works in Price, Utah; the College of Eastern Utah's Program for Technician and Foreman Training; the FMC Trona Mine Program at Green River, Wyoming were all cited as excellent examples which the government should review and use as models in developing its programs.

1.6 Employer-Employee Relations: Problems in this area are typified by the adversary position which has been taken by United Mine Workers in regard to new machinery and equipment with which advances in productivity may be made. The paper presented by a UMW official at the Productivity Conference in Tucson, Arizona was cited as an example of the attitudes of the union hierarchy in regard to advancing productivity in the coal mining industry. It was pointed out that not all unions have this attitude. In essence, the United Mine Workers had said the days of John L. Lewis are over and no jobs will be lost to new machines which serve to increase productivity in the coal mines. The proliferation of wildcat strikes throughout the nation and their affect upon productivity will never allow this country to meet the goals of Project Independence if they are allowed to continue unchecked. In some manner, an improvement in employer-employee relations is obviously needed.

2. Technology

2.1 The role of the U.S. Bureau of Mines as a clearinghouse for information came up time and again within this workshop. Flyers on the Technology Transfer program were distributed and, while attendees felt this program was good, they felt the role of the Bureau should be expanded. It was mentioned that a computer program data base with a memory containing all significant information on mining technology and operating techniques would be of immense aid to the industry. Often, in solving problems, the delay in getting the answer required is the biggest single cost factor. Quick response time is essential. Too often industry is shuttled from agency to agency in its attempt to get answers and thus a great deal of time is lost. A computer based response capability might solve this problem, especially if it could embrace inter-agency communication.

2.2 Dust: One of the majorproblems of the western operator in getting results from dust surveys is the fact that samples must be sent back to Pittsburg for analysis. It was recommended that dust analysis facilities be established in the west closer to the operations, or that industry be allowed to weigh the samples themselves to shorten the time between sample taking and the results being in the hands of the operator. It was also felt that the Dust Law needs to be revised to develop a more expedient way of sampling. The attendees felt that certain jobs such as continuous miner operator, roof bolt operator, should be sampled in a more or less continuous manner but certainly this is not true for timbermen and beltmen who are in low risk occupations and dust does not normally constitute a great hazard to them. The cassette problem and the "dumping" of samples by men as mentioned previously makes it nearly impossible to get true, representative samples and indicate the resentment the men seem to feel toward wearing the sampler. It was pointed out that many of the standards set forth in the dust sampling program are designed to satisfy the computer but, in many cases, do not seem to solve the problem. There was discussion that one of the best things that the industry could do to improve their position in regard to black lung and Workmens' Compensation is to make a thorough examination of the men they hire. It was pointed out that many fairly young men have serious respiratory problems due to excessive smoking from an early age. These men are then particularly susceptible to further lung damage if there is the slightest dust present in the atmosphere. Finally, it was recommended that at least part of the dust program have a centrally located dust sampler which would have a strong credibility in determining the atmospheric conditions in the mine and would serve to sample the overall air quality of the section.

2.3 Noise: Difficulties in meeting noise requirements were particularly severe in mines having hard roofs which required stopers for drilling. One of these mines has had to revert to rotary drills to meet the noise standard even though these drills are inefficient, have high bit costs and slow down operations. Many machines are excessively noisy and it was felt that equipment manufacturers could do more to dampen noise through modifications in original design of these machines.

2.4 Lighting: The glare problem associated with lighting was discussed at some length and it was felt that going to a red light source might eventually eliminate some of this problem. Also, it was pointed out that if all areas of the mine are well lighted, as in the ISMS System, the problem of glare does not seem to bother these men. This would seem to add strength to the concept of mine-wide lighting. Several of the attendees expressed disappointment with the lack of ruggedness of present lighting systems and the high cost of replacement of bulbs or reflectors. Perhaps as more mines use these new systems, the prices can be greatly reduced. Research should be continued to improve the ruggedness of all lighting systems. Since longwall will be a major mining system in the west, more work on lighting systems for longwall was recommended. It was also recommended that manufacturers could do a better job of light "mounting". Wells and protective coverings should be considered an integral part of machine design and not just "add-ons".

2.5 Roof Control: Hazard detection and methods for predicting conditions ahead of the mining face are badly needed. This is particularly true in the west where many mines will be put into seams in which no previous mining has been done. The inter-relationship of span, opening shape and stress fields were discussed in regard to stability. It was pointed out that there was no standard procedure employed by MESA for roof control plan approval. One attendee felt that the industry was put in the position of "bargaining" with MESA to find a roof control plan they would accept, rather than have an acceptable standard beforehand which states clearly to MESA and the industry in an engineering manner what is required. There was support for Technical Support and against them in their role in assisting the industry in developing roof control plans. Several attendees questioned the qualifications of MESA roof control "specialists". They thought that their training was inadequate and, to counteract some of their decisions, it was necessary for them to hire private consultants to assist them in "bargining" to obtain a roof control plan they could live with. The Bureau program of cabs and canopies in the ISMS System was cited as a worthy research effort which should help the industry. The miner-bolter program and the automatic bolter insertion program as well as the flexible roof drill were all cited as good programs presently underway.

2.6 Equipment Design: A strong recommendation was made that a diesel chock mover be designed which could handle a longwall support weighing from 5 to 16 tons. At the present time, scoops, portable hoists and shear manpower are used and if shields are to be used for mining 16' seams on an average 15° dip (Hanna, Wyoming), then an independently powered shield mover would obviously shorten the time for starting a new longwall, thereby increasing productivity and improve safety by eliminating the need for hand labor.

Research needs to be done on ways on which machine reliability can be improved. It was felt that in some cases machine design was overly complex and simplification would be possible if a real effort were made to do so. In the area of continuous transportation, it was felt that this is the answer to keeping the continuous miner "continuous". Industry felt it had not done enough itself and also that the government could do more. There is a need for equipment research into machines that move material into the mine. Too often, production scoops are used as utility vehicles rather than what they were designed for--producing coal.

2.7 Resource Recovery: While recovery in eastern mines by room and pillar techniques may be only 50%, if significant advances are not made, in many cases, only 20% will be recovered by room and pillar in western thick seams. All attendees felt it was to the national interest for the Bureau to do everything possible to assist them in maximizing recovery of coal in first pass mining and to work on secondary methods of recovery, including pillar robbing, caving systems and in situ burning to develop an ultimate high extraction.

2.8 Ventilation: The rigid duct system used at the Monterey Mine in Illinois was cited as an excellent example of ventilation control. More work was recommended to expand usage of cutting time by the continuous miner.

2.9 Long Distance Transportation: The conferees felt that one of the restraints against the development of western mines is going to be the problem of moving the coal to its place of utilization. Rail cars are in short supply. Many are obsolete and need replacement. While things have improved, railroads are not necessarily responsive to the needs of the coal industry. Slurry transport looks inviting but it has problems. A long range research program into the most economic and viable systems is needed.

2.10 Thick Seam Mining Systems: At the present time, there is no proven system for mining a large proportion of the thick seams in the west. Without a greatly accelerated effort by the government, no radically new system seems to be in the offing. Multi-level longwalls, top slicing and various forms of block caving have been recommended but until these methods are implemented, tired and proven, they hold no impact for increasing productivity in the west. It was felt that no one company could and would do the fundamental research that is needed and that this was a just and appropriate role for the Bureau of Mines to undertake. The pioneering work of the Bureau in oil shale in the late 40's and early 50's was cited as an example to support this contention.

2.11 Subsidence: Due to the problem of thick seam mining and multi seam mining of the west, and the fact that depth of cover can vary so radically over short distances, there is a need for a strong program into research on subsidence. While no specific recommendations were made as to how it should be carried out, it was felt that due to the thickness of seams, the problems would be uniquely different than those experienced in the eastern Unit States and, therefore, warranted research effort.

2.12 Refuse Disposal: Only one company specifically mentioned this problem but this company anticipates many new operations and is obviously wrestling with the environmental problem of waste disposal. They were particularly interested in slurry or pneumatic disposal of waste back underground.

CONCLUSIONS

The persons attending this workshop were well prepared to discuss real mining problems and are to be commended for their efforts. The written comments are in the appendix. It is the author's opinion that this report reflects the thinking of a good segment of the western underground coal industry and, therefore, recommendations contained therein should receive strong consideration in the formulation of Bureau research efforts.

LIST OF ATTENDEES

Tom Herman, General Superintendent, Mine #10, Box 530, Taylorville, Ill.

Arthur Garcia, P. O. Box 527, Emery, Utah 84522

Jim Brophy, Jr., Mine Supt., Sorensen-Elkol Mine, The Kemmerere Coal Co. Frontier, Wyoming 83121

Charles B. Tillson, Jr., Principal Mining Engineer, Kaiser Engineers, Oakland, California

P.J. G. D oit, Ingersoll Rand Research, Inc., Box 301, Prinecton, New Jersey 08540

George Oberlick, Atlantic Richfield Co., 1500 Security Life Building, Denver, Colorado 80202

Leon J. Mayhew, Rocky Mt. Energy Company, 404 N. St., Rock Springs, Wyoming

Blake L. Jones, American Coal Company, Huntington, Utah

Clifford E. Oviatt, American Coal Company, Hungington, Utah

Lovon Day, American Coal Company, Huntington, Utah

Adam Robinett, Braztah Corporation, Helper, Utah

Bob Gunsorek, Braztah Corporation, Helper, Utah

Paul Russell, Research Director, USBM - Denver Mining Research Center, Federal Center, Denver, Colorado

Tom Morgan, Research Engineer , " " " " "

Joe Smith, State Liaison Officer, USBM - Federal Center, Denver,Colorado

APPENDIX I

WESTERN UNDERGROUND COAL MINING WORKSHOP RESEARCH AND DEVELOPMENT PRIORITIES

by

Jim Greenlee
George Oberlick

Atlantic Richfield Company

I. Improve Mine Safety

  A. Hazard Prediction

    1. Strata methane

    2. Fault zone

    3. Spontaneous combustion

  B. Hazard Detection

    1. Coal bump areas

    2. Subsurface heating

  C. Hazard Alleviation

    1. Pillar destressing

    2. Mine design improvements

    3. Coal seam cooling

    4. Panel isolation

    5. Seam degassification and methane sales

II. Refuse Disposal - Underground

  A. Pneumatic Storing

  B. Slurry Disposal

III. Resource Recovery

  A. Multiple Seam Mining

    1. Rock mechanics

    2. Mine design

    3. Operations sequencing

    4. Ventilation

III. (cont'd)

- B. Thick Seam Mining
  - 1. Tall pillar stability
  - 2. Multiple pass system
  - 3. Caving system
- C. Pitching Seam Mining Systems

IV. Mine Productivity

- A. Longwall and shortwall mining
- B. Continuous transportation
- C. Roof support technology
- D. Internal combustion engines underground

V. Coal Quality Improvement - Cleaning and Drying

VI. Long Distance Transport Techniques

- A. Spontaneous combustion reduction
- B. Slurry transport

USBM CONTRACT NO. H0242034

RESEARCH AND DEVELOPMENT PRIORITIES
ROOF CONTROL CONFERENCE - April 15-16, 1975

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June 1, 1975

Prepared for the
U.S. Department of the Interior
Bureau of Mines
Washington, D.C. 20240

NOTICE

The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies or recommendations of the Interior Department's Bureau of Mines or of the U.S. Government.

Introduction

This report is the eighth of a series reporting findings from workshops held with various segments of the Mining Industry under United States Bureau of Mines Research Contract No. 242034. This meeting was held in Rolla, Missouri, on the campus of the University of Missouri-Rolla, on April 15 and 16, 1975.

The workshop followed the outline which is attached. Unfortunately Dr. John Reed could not be present, but Dr. Richard Bullock filled in for him and gave an excellent overview on roof control. Each of the speakers was asked to present an abstract covering his remarks. Dr. Findlay did prepare a complete paper which is included in this report. The paper given on Friction Rock Stabilizers by the author is the same as was presented at the Society of Mining Engineers in Acapulco, Mexico, in September, 1974.

Each of the chairmen of the work teams which met on the second day presented his recommendations in written form and these are included in this report. The open discussion period has been covered by the author and reflects his thinking as to what was said.

Following the meeting, various participants sent letters to the author which reflect their thinking as to the most important R and D projects. These letters are attached in the appendix.

Workshop Sequence

The author opened the workshop with an overview of the greatly expanded research program of the U.S. Bureau of Mines and the impact that it should have on the industry. He emphasized the fact that funds are now available, not only for health and safety research, but also for productivity studies. The goal of the workshop was defined as one of assessment of the present state of mining technology and roof control and, based upon this assessment, what research projects should be pursued by the Bureau of Mines to best aid in the promotion of health and safety and productivity. The author then introduced Dean Ted Planje, Dean of the School of Mines and Metallurgy, UMR.

Dean Planje welcomed the conferees to the campus and elaborated on the role of the School of Mines and Metallurgy in the education of mining engineers and in the school's role to contribute wherever possible to advance the state of the art of mining.

Dr. Richard Bullock opened the technical side of the conference with a roof control overview which covered, in a very broad fashion, the present status of roof control in the United States. Dr. Bullock conferred with Dr. Reed previous to the presentation and for all practical purposes, followed the presentation given by Dr. Reed at the American Mining Congress fall meeting held in Las Vegas, Nevada, in 1974. This paper is attached. Points emphasized in Dr. Bullock's presentation include:

1. To be effective, rock bolts must pre-stress the rock.
2. Fully bonded bolts are more effective than point anchored bolts.
3. The load distribution along a fully bonded bolt is not understood.

4. There is a need to improve mine designs to minimize roof control problems.

5. There is a need for a practical roof fall warning device.

6. There is a need to improve initial support to prevent re-support problems.

7. A thorough review of everything that has been done in roof control should be undertaken by some group as a means of communicating and educating the industry as to what is available.

8. Thick seam mining in the West will present new problems which will have to be solved, such as, how to bolt a high back and how to install bolts in pillars to prevent slabbing.

9. There is a need to work on the compatibility between the rate of mining and the speed with which supports are installed.

After lunch Dr. Jose Agapito presented a discussion on Roof Bolt Technology, Standard Bolts. Dr. Agapito did not prepare an abstract of his paper but he did send a letter reflecting his thinking which is attached in appendix C. From the author's notes, the following five factors were considered most important by Dr. Agapito in his presentation:

1. What is the function of a roof bolt?

   Is it to suspend the material, to build a beam? Often it is found that 1 in 4 bolts is loose. How then can they be effective? The function of geology is not understood by the operators and many do not take advantage of simple observation techniques such as convergence and extensometer measurements to better understand roof bolt function.

2. Pattern of spacing

   Little work has been done on this problem and one might say that the industry has standardized on a 4 x 4 pattern and seldom deviates from it.

3. Assembly and installation

   The various components of the bolt were discussed including the plate's action against the rock, the friction between the bolt head and the plate, the fact that the steel does not fill the hole, the anchor rock interface, bale design, threads, friction and torque tension relationships.

4. Quality control

Standard roof bolts are greatly affected by the skill of the operator in installing the bolts and his awareness of the role of the roof bolt in ground support. Adequate education and training is essential. Blasting vibrations were discussed in regard to causing loss of anchorage. The merits of direct tensioning rather than torqueing the bolt was discussed.

The discussion following Dr. Agapito's presentation pointed out the need for more studies in mines, the need for a direct tension reading indicator, the need to lubricate and protect standard bolts to prevent corrosion, and the need to measure ground movements if the true effect of standard roof bolting is to be determined.

Gary Greenfield of Celtite Corporation next presented a paper on Resin Roof Bolt Technology. Mr. Greenfield did not have an abstract of his paper and the following are the author's judgment as to the points most emphasized.

The past history of resin bolting was discussed with emphasis that much of the technology employed today in the United States is really an outgrowth of European practice, practically in France. The fully bonded tensioned and untensioned rock anchor is, in most cases, superior to the standard bolt, but also is more costly. Work is being carried on on point anchor resin bolts and on two-speed resin systems with a fast-set resin at the back ot the hole and a slower setting resin near the plate in an attempt to create a pre-stressed, fully bonded condition in the rock. The beneficial effects of pre-bolting of ground, as for example, in the mining of overcasts, to prevent having ground control difficulties in these abnormally large openings. Factors affecting quality control of resin systems include the need for personnel training, the need for slow rotation of the rebar and the need for adequate holding time of the rebar. Resin should not be stored for long periods of time and particularly not at high temperatures as it affects their quality. The size of the hole and the thickness of the resin around the rebar affect the quality.

From a cost consideration, resin bolts are expensive, but they have served as a substitute for steel and timber and at the present time often allow shorter bolts to be installed than when standard roof bolts are used. Recommended research areas include:

1. How long should resin bolts be?
2. What should be the spacing?
3. What is the best combination of bolt diameter, steel diameter and resin thickness?
4. Is uplift in the roof produced by bolter during the holding action deterimental to the roof?
5. How can personnel be better trained?
6. There is a need for a simple monitoring system to determine the effectiveness of resins.

Lars Olavson presented a paper on the pumpable bolt system which his company has developed under contract to the U.S. Bureau of Mines. This system uses fiber glass reinforcement in combination with resin to create a fully bonded roof reinforcement. Mr. Olavson's paper was similar to that given at the A.I.M.E. and a copy of his paper is attached.

Alan Weakly, Mining Research Engineer, St. Joe Minerals Corp. then presented a paper on Room and Pillar Ground Control Utilizing the Grouted Reinforcing Bar System. An abstract of his paper is attached.

The final paper of the day was given by the author entitled Friction Rock Stabilizers and Their Application to Ground Control Problems. This paper had been presented previously at the fall meeting of SME in Acapulco, Mexico, 1974. A copy of that presentation is attached.

Due to the shortness of time, few questions and little discussion was allowed on the afternoon papers. Discussion of these papers is brought out in the work team reports.

The evening was spent in informal discussions at a buffet dinner at the home of the author and at Zeno's Steak House.

Second Day

Dr. Walter Findlay, Research Director, White Pine Copper Co., presented a paper on White Pine's experience in roof control. It covered present technology, raised many questions and suggested where we might be going in the future. His paper in its entirety is attached.

In the author's opinion, Dr. Findlay emphasized certain areas for research. They are:

1. Research into grout types.
2. Research into various ratios of grout and steel in the hole.
3. Anchorage [illegible] [illegible]les.
4. Quality control.
5. Time lapse between blasting and bolting.

6. The possibility of elimination of drilling and blasting and consequent damage.

7. Development of a flexible roof drill.

8. Development of a micro and macro roof sag indicators.

9. The development of an adhesive bond grout.

10. There is a need for a roof control handbook somewhat similar to the Blaster's Handbook.

11. He recommended field testing program of bolts in conjunction with advance caving and pillar robbing.

Work Teams

At mid-morning of the second day, the conferees were divided into four groups to make recommendations in the following areas:

1. Standard bolts
2. Resin bolts packaged
3. Pumpable systems, resin and cement
4. Other methods such as trusses, roping, friction rock stabilizers, etc.

The recommendations of each group follow.

I. Standard Rock Bolt Research

A. Investigate the original structure in organization and purpose of government agencies involved in roof control. There seems to be little coordination between government groups and, since ground control is so important, everything possible should be done to minimize overlap and improve efficiency.

B. All available data on roof and rock bolt performance should be collected and correlated to enable all parties, including government, industry, academic, etc., a library to obtain the most up-to-date information.

C. A research and development program should be formulated to assess the function and the performance of roof bolts.

D. An educational program broad in scope, should be implemented to educate roof bolters in the function of the bolt, the need for quality control and his personal role in health and safety of others as well as himself.

E. We should assess the possibility of developing a standardized criteria for certifying roof bolt operations before they are put on the job and at intervals thereafter.

II. Resin Bolt - Package

A. Develop design data and criteria for fully grouted bolts.

B. Develop proper installation techniques to assure quality control.

C. Monitor stresses along the bolt length to understand the bolt function.

D. Determine the roof support interaction between the grouted bolt and the plate or header or metal strip or timber.

E. Do research to develop an expansive resin to safeguard against shrinkage.

F. Determine whether or not uplift provided by the roof bolter during the holding period when the resin is setting up is good or bad for roof control.

G. Assess the proper geometry for resin bolting, hole size vs. steel size vs. quantity of resin.

H. Develop a testing method which will adequately record the effectiveness of a fully bonded bolt.

I. Improve education and communication between the government, suppliers and the users.

III. Pumpable Systems, Resin and Cement

A. Materials research

1. Area of lower cast pumpable materials
   a. Other grouting material
   b. Other grouting additives

2. Area of more efficient application of grouting materials
   a. The liquid part of system
   b. The tensible part of the system
   c. The systems where the liquid part becomes the pumpable part

B. Testing systems or areas that need to be identified.

1. Does a fully grouted bolt need the same tensil strength as a point anchor system?

2. Identify where the head or plate is actually needed.

3. Identify what properties are really important to rock support.

   Example: Tensile properties: sheer properties compression: time effect on the above (minutes - weeks - years)

4. Area of tensil - testing
   a. work on sonic velocity methods
   b. work on pull-test methods
   c. interelate with time

5. Testing the rock
   a. convergence - sag
   b. borehole scope
   c. horsy type gage
   d. shear testing

6. Develope a standard testing procedure to be followed by industry.

C. Trade off analysis on comparison of each system at various points of the research study, using:

1. Cost

2. Efficiency and speed

3. Safety

4. Effectiveness

A weighted measure of these and other variables should show the strength and weakness of each system. The weaknesses should be singled out to determine if they can be improved or if the work on that weakness is futile. If futile - eliminate the system.

D. Finally, the cost-benefit ratio of the best systems that emerge.

E. Recommend that regulations on ground control systems be withheld until the proper information is researched and compiled. At least, allow the flexibility to the Bureau and to industry to develop known and better roof control methods.

IV. Other Methods

A. What is the value of a pre-stressed, fully grouted mechanical bolt vs untensioned grouted bolt under various mining situations?

B. The Split Set System utilizing Friction Rock Stabilizers should be investigated from the following viewpoints:

   1. Develop a design handbook for steel diameter, thickness and interference.

   2. Determine performance under various geologic conditions, hard shales, soft shales hard igneous rocks.

   3. Design installation equipment and procedures.

   4. Do economic analysis.

   5. Investigate shear resistance of Split Sets.

   6. Investigate the value of yield ability of Split Sets as rock moves.

C. Truss Systems

   1. Investigate cable and beam trusses

   2. Determine benefit of combination systems using various grouted bolt anchor arrangements, cables, straps or beams.

   3. Determine geologic conditions where trusses should be applied.

D. Information Exchange

   1. Develop a means of pooling and making available to users information available to the Bureau of Mines, MESA, Army Corps of Engineers, Bureau of Reclamation, ASTM, etc.

E. Investigate novel bolt materials such as wood, fiber glass, cements, plastic foams, etc.

   1. Investigate novel approaches, such as resin bonded rock beams, in situ pressure grouting etc.

   2. Investigate roof support costs as a function of productivity of the mine.

   3. Investigate new mining plans or systems which allow novel or less costly support systems than are now being used.

4. Investigate rock deformations, as a function of a support system used.

After lunch, research work being carried out by Dr. Charles Haas on a direct shear machine was discussed. A visit to his laboratory was made and conferees saw firsthand the equipment and bolting systems that have been pulled to failure.

After this, the work teams presented their reports and the conference was completed with an open discussion. The conferees were asked to send in their written comments if they desired to have them included in the report. They are included in appendix C.

Conclusion

The conferees at this conference worked hard and showed a great willingness to put forth their ideas as to what research work should be done. The reader should read this report in its entirety to obtain detailed areas for investigation. The author will attempt to suggest broad areas which cover the many detailed studies.

1. The fundamental mechanism of the roof bolt, both point anchored and fully bonded is still not understood and needs more investigation.
2. A data bank of information should be established by one group or agency to serve as the communication base for present and future roof control studies.
3. Fully bonded resin bolts and their function is not understood and research should be done to determine such factors as stress distribution along its length, the need for pre-stress, the angle, spacing, pattern and length that are most desirable and the ratios of steel to resin which are most effective.

4. Productivity research should be conducted to determine the cost benefit ratio of bolting as opposed to other support methods and to determine ways in which roof control can be made compatible with other functions within the mining system.

5. Extensive field tests are necessary on all support systems and the Bureau should play a leading role in this test procedure. Rock deformation should be used as the criteria for adequacy rather than some more or less ambiguous test such as torque for determining the effectiveness of the bolting system.

6. Novel systems of support should be investigated by the government as industry does not have the inclination, manpower and resources to carry on such efforts.

RESEARCH AND DEVELOPMENT PRIORITIES FOR TOP MINE MANAGEMENT

INSTITUTIONAL PROBLEMS

February 18, 1975

By

James J. Scott
Principal Investigator

U. S. Bureau of Mines

Contract No. HO242034

Introduction

This report is the seventh of a series held with various segments of the Mining Industry under United States Bureau of Mines Research No. HO242034.

This meeting was held in New York City on February 18, 1975. Two top management persons representing several major companies, were present. The names of attendees will not be given.

This meeting was quite informal and no formal attempt was made to set priority numbers on the various subjects discussed. The order in which they are presented is a reflection of the writer's judgment as to which is most impotant.

Discussion

1. The U. S. Bureau of Mines should strive to develop a strong professional stature. This should be done by well-developed programs in Research and Development coupled with thorough, professional investigation to assure that the needs of the American Mining Industry are fully met.
2. The Bureau of Mines should be the center of research and development for the mining industry. Work upon minerals problems has been already broken up in such a manner that the industry has great difficulty in getting answers to its questions and inquiries when visiting Washington. In regard to MESA doing research and development work, the conferees were in opposition to this, feeling that the Bureau should be the agency responsible for research.
3. Equipment manufacturers should be closely involved with Bureau research and development. It was felt that mechanization is the key to improving productivity and health and safety so that a close alliance with equipment manufacturers is absolutely essential.
4. The Bureau should serve as a center for dissemination of information involving new technologies for the

industry. This is particularly true in terms of international mining practice where, in some cases, the practices in Europe are not fully understood or utilized by the American Industry.

5. The Bureau should lead in the technical innovation of new systems and approaches to mining problems. Areas which were singled out for work were longwall mining of deep coal desposits, drilling, explosives, transportation, rock mechanics, wheel excavators for surface mining in the arid West, and it was felt in-situ mining systems should be pushed.
6. In the area of education and training, the Bureau should work to develop training courses for technicians, for one and two year courses beyond high school, to develop young people in the areas of drafting, electrical repair, mechanical repair, ventilation, welding, practical geologists, etc. These programs should be offered to the persons in the geographic locations near mining operations.
7. Industry is willing to have the Bureau of Mines do research in its mines but they are against financial entanglements which involve them in a monetary manner. The participants felt thev had never benefited from entering into a business deal with the Government. In fact they go out of their way not to do business in a direct way with the federal government.

Following are areas that the participants felt the Bureau of Mines should not involve itself in:

1. Economic studies of the Mineral Industry in the past by government agencies have been unrealistic in the real business world. Since the Mining Companies are taking the risk, it is necessary for them to do their own financial analysis and there is little to be gained by Bureau participation in this area.

2. It was suggested that the Bureau should not try to follow the examples put forth by the British Coal Board, as they feel this organization is extremely inefficient. They did speak highly of German research efforts.
3. Many of the contracting agencies which have Bureau contracts have no knowledge of mining technology and have little technical expertise to offer the industry. Participants were totally sceptical of these people ever coming up with viable solutions to the problems of the industry.

Conclusions

The two participants in this meeting are probably the most influential in the entire mining industry of the United States from the management side. They were forthright and, in the opinion of the writer, held nothing back as to the role the Bureau should play. Serious consideration should be given to being responsive to their needs and desires.

Respectfully submitted,

Principal Investigator

RESEARCH AND DEVELOPMENT PRIORITIES FOR TOP MINE MANAGEMENT

INSTITUTIONAL PROBLEMS

January 20, 1975

By

James J. Scott
Principal Investigator

U. S. Bureau of Mines

Contract No. HO242034

Introduction

This report is the sixth of a series held with various segments of the Mining Industry under United States Bureau of Mines Research No. HO242034.

This meeting was held in Washington D.C. on January 20, 1975. Five persons, representing three companies, were present. Two companies who were invited did not attend, due to the disruption of their travel schedule by a snowstorm. A second top-management meeting is planned for February 18 in New York City to obtain the input of these companies and others.

This meeting was more informal than others and was less structured in the process of setting priorities. The priority numbers have been developed by the writer and reflect his impression.

Priorities

Perhaps due to the fact that this meeting was held in Washington D.C., almost all of the problem areas reflected, in one form or another, Government regulation or action. A listing is as follows:

1. Too much government interference in the workings of the industry.
2. Excessive regulation and unrealistic standards.
3. Adversary position of MESA.
4. The U.S. Bureau of Mines should be the advocate of the Mining Industry.

5. Patent restrictions need to be relaxed to encourage new development by the Industry and Equipment companies.
6. There is a need for better education and training programs.
7. There needs to be closer communication between top management and the directors of regulatory agencies.
8. Research contracts should have continuity through the various phases to allow the contractor to maintain continuous employment and job assignment.
9. The Black Lung Benefits program and its cost to Industry should be studied.
10. Productivity research should be a major thrust of the Bureau along with the assurance that health and safety are not sacrificed.
11. Conflicts between government agencies should be resolved so as not to catch Industry in the middle.

Discussion

1. Government interference in the obtaining of coal leases and the development of them has stymied initiative and placed roadblocks before the Industry that are near insurmountable. Conflicts between Bureau of Land Management, the Forest Service, Bureau of Indian Affairs, U.S.G.S., E.P.A. have all served to retard any movement toward Project Independence. The above problems are primarily in the development

of Western coal. During this discussion it was pointed out that consideration should be given to the problem of the remoteness of these operations in that it was felt there could be some relaxing of environmental standards particularly in the area of air and water quality. A realistic approach to standards was emphasized.

2. The effects of excessive regulations seem to have the most effect upon underground coal operations. The requirement of methane monitoring at the face in an almost continuous manner was discussed. The conflict between the State regulation in Pennsylvania for a safety lamp and the Federal regulation for an electronic methane monitor was an example of the problem. The need to keep a brattice curtain within 10 ft. of the face is another major production obstacle. It was felt that Research and Development should be completed and results applied when the standards are developed rather than try to do research and development to fulfill a standard after it is promulgated.

All companies emphasized they did not fear a good safety inspection and, in fact, desired it. But when standards are unrealistic and agencies are in conflict with each other, there is little chance that the inspection will be beneficial.

3. While the conferees did feel that much improvement had been made over the past, they still felt that MESA approaches the Industry from an adversary position. While there was agreement that MESA must remain somewhat aloof of the Industry,

it was agreed that inspections should be impartial and be conducted by technically qualified people. The Industry should have the opportunity to correct and respond on the spot to conditions the Inspector thinks are unsafe and otherwise need remedial action.

In regard to the question of research being done by MESA there was unanimous agreement that research should be done by the Bureau of Mines and should be directed by the Bureau of Mines. Input for that research should come from all available sources but responsibility should fall with the Bureau. Putting the research organization or funds for research into MESA would result in the same conflict of interest condition which existed with the passage of the Act and until MESA was formed.

4. It was felt by the conferees that the U.S. Bureau of Mines should be in essence, the Mining Community Bureau. This includes labor as well as Management's Bureau. It was felt that there is a need for an Government agency to be the advocate of Mining as a counteraction to the proliferation of agencies which serve to be counter-productive and, essentially, against the mining industry. There was feeling that this was perhaps part of the intent of the Minerals Policy Act that advocated a strong domestic mineral industry. There was discussion that it would be very helpful if the Director of

the Bureau of Mines would come forward to meet Mine Management more often to establish a greater spirit of cooperation between this agency and the Industry.

5. Government patent regulations were discussed particularly with regard to the development of new equipment and it was felt that present patent practices are too restrictive and tend to keep equipment companies from fully devoting their resources to mining problems in the manner in which they would like to. It was felt that the patent policy could be relaxed without any loss to the government.

6. Problems in education and training were discussed from the standpoint of who should do them and how programs should be conducted. It was felt that large companies have the financial base to contribute more to education and training than can the small operator, but even large companies need assistance on the broader aspects of technician training and development of specialists. The general consensus seemed to be that there needed to be some government involvement, but the companies also have a strong responsibility in this area. Research into curriculum offerings and into motivational studies were suggested as areas for Bureau work.

7. It was felt there was too little direct communication between the top managers in the Industry and the top level directors of Government. All attendees recognized the problem

that no Government Agency can be beholden to any one segment of our society but, in the interest of that society, it would certainly appear that closer lines of communication are needed. It was felt that the Mining Industry is not large in terms of its population, but it is a giant in terms of its contribution to the health and well-being of all of society, due to its basic role of providing of raw material.

8. Many research contracts are let with the work being done in perhaps three or four phases. Each phase serves as a stop point to determine the progress of the project and to ascertain if work should be continued, changed, or perhaps terminated. These junctions between phases of work tend to place a real hardship upon the contractor in terms of maintaining his labor force and planning continuity into his work effort. Therefore, it was suggested that the Bureau make every effort possible to assess the progress of research at each phase approximately 60 days previous to the phase termination and, at that point, give the contractor, with as much certainty as possible, a statement as to its intent with regard to funding of the next phase. If this can be done, many of the contractor's labor problems will cease to exist.

9. The Black Lung Benefit program, as it now exists, is a major problem to the Industry. The supposition that if a man works several years in the coal mining Industry that he has,

then a right to Black Lung Benefits, is a conclusion that is not founded in fact, and one which should not be perpetrated against the Industry.

It was pointed out that the only way this program could be financed is through revenues from the sale of coal and, in this context, is not only an Industry problem, but is a problem for every consumer of the final product. The problem for the Industry is more severe as there is no guarantee that these costs can always be passed along to the consumer. It was postulated that if an Industry is meeting respirable dust standards it would then be impossible for any of its employees to develop Coal Workers Pneumoniconiosis. This, in itself is a contradiction within the Federal Statutes and certainly needs correction.

10. One of the conferees made the statement and I quote, "The loss of productivity in the American Bituminous Coal Mining Industry is a national tragedy." Figures were quoted by coal producers that their production had dropped from 1.3 tons per manhour to 0.9 tons per manhour, as a result of unrealistic standards and overzealous regulation by the government. Such productivity losses in an industry as basic as coal can only, in the final analysis, result in a drop in the living standard of all of the populous.

11. Agency power struggles were cited as one of the reasons for Industry being over-regulated and, in some cases, being caught

in the middle so that it was impossible to comply with two conflicting agencies. A case in point was the noise standard of OSHA at 90 DBA and of EPA at 85 DBA. The present struggle by MESA to take over research funds associated with the Coal Mine Health and Safety Act is another example.

12. Miscellaneous. It was the author's feeling, that the Industry felt there was little consideration given to their role in establishing a good safety program. An example of this fact is that a major coal producer has mined over 200 million tons of coal and has not experienced a single dust explosion. Yet the same company is presently being badgered by MESA in regard to coal dust clean-up procedure, rock dusting procedures and, when one analyses their past record, one wonders why. It might be better if MESA studied this company's procedures to find out why they have been so successful instead of thinking up ways for them to do things differently.

Conclusion

Many of the problems defined in this report are beyond the scope of the Bureau of Mines Research and Development program to solve. But it is hoped that this documentation of these problems can serve as a springboard in communciation to other government groups and, particularly, to the hierarchy of the Department of the Interior, that all is not well. All of the good words and rhetoric in the world will not solve the problems of the Mining Industry and only by facing up to these institutional problems defined in this report can any real progress be made.

Respectfully submitted,

James J. Scott

Principal Investigator

RESEARCH AND DEVELOPMENT PRIORITIES
FOR THICK SEAM WESTERN COAL MINES

Denver, Colorado
November 12, 1974

By

James J. Scott
Principal Investigator

U. S. Bureau of Mines
Contract No. HO242034

Introduction

This report is the fifth of a series reporting findings from workshops held with various segments of the Mining Industry under United States Bureau of Mines Research Contract No. HO 242034.

This meeting was held in Denver, Colorado, on November 12, 1974, at the Petroleum Club. Representatives of 6 companies operating in the West were present. Two reporters from the U. S. Bureau of Mines assisted in taking notes. Mr. Joe Smith, State liason officer for Colorado, was very helpful in making arrangements for this meeting.

The morning session was devoted to problem definition with each company appraising its own situation. The afternoon was used to combine together research areas of common interest and to set up a priority listing as to their importance to the company. This report covers my impressions and the priority listings as developed.

Priorities - General Rating

Eight broad categories were developed at this workshop. They are:

1. Manpower
2. Government regulations
3. Public relations
4. Reclamation
5. Technical - mining
6. Technical - preparation
7. New systems - surface
8. New systems - underground

Each of these categories have sub-categories which will be listed and, where appropriate, comments to clarify will be added. The problems are ranked in order of importance, number 1 being rated most serious, etc.

Priorities - Specific Areas

I. Manpower-Supervisors, Union and Staff Personnel

1. Employee attitude towards job, company, and safety should be researched to improve efficiency and individual performance. Off-job research to determine factors which affect on-the-job performance should also be considered.

2. Training. Both on-the-job training and new-employee training were stressed in this workshop. This is probably due to the fact that western operations are normally in fairly sparsely populated areas and often the labor force has little training in operation of large pieces of equipment.

3. Incentive programs. Research is needed to define incentives which will really result in increased productivity. These studies might also fall in the category of worker motivation.

In our discussions of manpower it was brought to light that the average capital investment per employee varies from $130,000 to $225,000, taking into account everyone on the property. This large capital investment would seem to make it mandatory that worker efficiency and productivity be kept at the highest possible level.

II. Governmental Influence

1. The need for consistant interpretation of rules and regulations was stressed in this meeting. All too often different inspectors from the same agency came up with different interpretations

for the same hazard or operating procedure. These differing interpretations have proven to be extremely costly to the operator.

2. Eliminate overlapping agencies whenever possible. The mining operations in the West, because of the large public land acreage are obviously plagued with this problem. The attendees complained of overlap between Bureau of Land Management, U.S.G.S., MESA, OSHA, Bureau of Indian Affairs, Fish and Wildlife, EPA, at the Federal level, and these all overlap on State agencies with similar responsibilities as well as some local and county agencies. Because of the complexity of these problems and the political ramifications, an in-depth study would certainly be needed.

3. The need for qualified governmental personnel was emphasized. Training, attitude studies, motivational studies, as well as a review of the method by which governmental employees are selected for the special inspection jobs should all be examined. It was felt that the government employee needs training just as much as the industry employee.

4. Studies are needed to make the technical support offered by government more effective. The Technical Support Group under MESA was cited as a group which was not being responsive to the needs of industry. The principal criticism was that the government representative was only willing to play a passive role and it was always necessary for industry to be the active participant in formulating any solutions. At this point the government agent will say yes or no to the plan, but he assumes no responsibility in its success. The operators expressed the need for help but

they would like the government representative to be a full partner and actively use his professional expertise to arrive at solutions.

5. There is a need for Industry-Government employee exchange program. In this program a company employee might work with the inspector for two to three weeks per year to gain knowledge of the problems of the governmental employee. At the same time the governmental employee could be employed by the company in a supervisory position or a manager position and he would perhaps then develop a better understanding for industry's problems.

6. Research into methods to develop a realistic National Land-Use and Mineral Policy is vitally needed. Expanding of production in coal mining and meeting the goals of Project Independence have little change if such a National policy is not forthcoming.

III. Public Relations

1. There is a need for social and economic studies to show the impact of mining on local communities as well as its role in the national scene.

2. Research is needed into public information programs to determine the most effective method of informing the general public of the role of the mining industry. Methods to be reviewed include: films, T.V., newspapers, magazines, seminars, schools, etc.

3. Research is needed to develop a unified approach to the public relation problems of the industry on a national basis. Too often people who do not represent the majority of the industry, are vocal and outspoken, widely quoted, and thus a false impression of the role of the industry is generated.

IV. Reclamation

1. Materials-handling research to develop methods for selective strata control to separate top soil from rock and place it on the spoil pile in the most advantageous manner, is needed. New concepts in equipment and mine planning were emphasized.

2. Eliminate Government agency overlap and inconsistencies in just what is to be done in the area of reclamation. The conferees pointed out that many of the new agencies in this area have little idea of what they want done or how to do it. They did find that their local agricultural agents from the Department of Agriculture were most helpful and they were full of praise for these men.

3. It was recommended that Industry - Government reclamation workshops be held to zero in on what are the Research and Development priorities in the area of reclamation.

4. Research into vegetation studies, irrigation for the initial establishment of vegetation and methods for the control of noxious weeds is needed.

5. Research into the post-mining land-use planning should be considered. The conferees felt that many times mining operations presented a unique opportunity to completely change the end-use of the land, but agencies seemed prone to only suggest reclamation plans which would bring the land as nearly as possible to its original use.

V. Technical Solutions

It was hard to get this group to zero in on anything of a technical nature, but after sufficient prodding, they did come up with the following list:

1. Noise research. Due to the size of the equipment used, in the open pit operations, the noise level of operation is high. It was felt that a thorough study of these noise levels should be made to develop rational solutions before promulgating standards.

2. Dust research. The inherent nature of the mining operations in the semi-arid regions of the West are that they are dusty. The operators pointed out that before mining occurred, there was a natural dust level on windy days which is quite high. They felt that regulatory agencies were not taking this natural dust level into account when inspecting their operations or when citing them for excessive dust. They felt research was needed into the sources of the dust, methods of control and sampling procedures.

3. Drill-Blast Research. This relates particularly to overburden drilling and blasting and to the fact that numerous new blasting agents and scarcity of ammonium nitrate are presenting new problems. The cost of operation is greatly affected by the amount of blasting required, and as seams dip, this can be the controlling cost that limits the depth of mining.

4. Research is needed to develop a reliable mobile air-conditioner for moving equipment. Often equipment costing hundreds of thousands of dollars will sit idle because the air conditioner is not functioning and the man will not operate the vehicle until it is working. This results in losses in productivity and large

dollar losses for the company. Dust and vibration seem to be the principal problems in keeping the air conditioners functioning.

5. There is a need for a reliable, low cost pager which can be used by the Foreman to communicate with men at some distance on an individual one-on-one basis.

6. Research into hazards and their solutions for compartments on large equipment should be considered. These hazards sometimes show up most during periods when maintenance is being done.

7. Equipment reliability research is needed. Some method to improve the dependability of equipment and to be sure that it is capable of doing the job for which it was purchased. This research might be done in cooperation with equipment manufacturers.

VI. Preparation Plans

1. Noise research

2. Dust control research

3. Research to develop dry separation systems which could operate efficiently under cold weather conditions.

4. Research methods of freeze-proofing coal for shipment.

5. Research into methane-control within preparation plans.

VII. New systems and associated equipment for surface mining.

1. Research to develop a one-pass machine that would strip the coal, mine the seam and eliminate rehandling of material. This would require a major effort to integrate all present functions.

2. Research on selective strata reclamation is needed. In some cases a strata at some depth within the overburden is more desirable on the surface after reclamation than the top soil which was originally there. This may be due to the fact that the ground was over-grazed or had been leached excessively.

3. Research into in-situ systems for coal recovery is needed.

4. Research to develop better systems for extraction of steep pitching seams which are quite prevalent in the Rocky Mountain area.

VIII. New Systems and Associated Equipment Underground

1. Research for thick-seam extraction

2. Research for control of methane during the thick-seam mining process.

3. Research into the cause-effects and remedial action of subsidence.

4. Research into new mining systems for steep-pitching seams.

5. Research into the problem of multi-seam mining to develop methods to sequence mining in the most efficient manner and maximize recovery of the coal seam.

Conclusions:

This workshop was well attended and the people actively presented their views. It was again difficult to get this group, as it has been with other groups, to zero in on technical problems. And perhaps this workshop can be best summarized by the statement of one of the conferees when he said, "The most important problem of the Mining Industry today is the People Problem."

If you have questions on this report, please feel free to contact me for clarification.

Respectfully submitted by:

James J. Scott

James J. Scott
Principal Investigator

JJS/lrv

APPENDIX

Attendees:

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2. Arnold M. Hannum
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3. Roger Dewey
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4. Don Huckeby
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5. Stuart R. Felde
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6. Larry C. Fuller
VP Operator & Engineer
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Consol - Denver, Coloardo

7. Morgan L. Bryant
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8. George Schottler
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RESEARCH AND DEVELOPMENT PRIORITIES
FOR LIMESTONE OPERATIONS
STATE OF MISSOURI

October 17, 1974

by

James J. Scott
Principal Investigator

U. S. Bureau of Mines

Contract No. HO242034

Introduction

This report is the fourth of a series reporting findings from workshops held with various segments of the Mining Industry under United States Bureau of Mines Research Contract No. H0242034.

This meeting was held in Rolla, Missouri, on October 17, 1974, at the Mining Department, University of Missouri-Rolla. Seven representatives from six different companies were present. The list of attendees is shown in the Appendix.

The morning session was devoted to problem definition with each company appraising its own situation. The afternoon was used to combine together research areas of common interest and to set a priority listing as to their importance to the company. This report covers my impressions and the priority listings as developed.

Priorities - General Rating

It was extremely difficult, with this group, to get them to seriously consider the technical problems of Research and Development that confront the industry. All of the participants were extremely vocal in their criticism of the Government, both Federal and State, for their interference in the problems of operating small quarry operations, both surface and underground. Since the participants, more or less, represented independent entrepeneurs, and all represented small operations that in no way can afford specialists to deal with the many faceted problems of government control, it is probably not surprising that this extreme frustration manifested itself in this workshop. Bearing this in mind, the following are the principal categories and their order of importance as developed by the group.

1. Communication problems
2. Standards - Realistic and unrealistic
3. Labor-Management problems
4. Safety and Health
5. Equipment
6. Environment

Priorities - Specific Areas

I. Communication

1. Labor-management - government - public problems

The conferees felt this whole area needed research with its goal to establish means of improving communications between these groups. The red tape of multiple report forms put out by government agencies, which require the operator to submit repetitious information but in slightly different form, to government groups presents a time-consuming, almost insurmountable task to a small operator. Perhaps one all-inclusive report might be filed by the operator with one government agency which would serve as a clearing house for this information to others.

2. Expand technology transfer program

Small operators are obviously not aware of the technology transfer program and the large amount of information that is presently available to them through government research efforts. A concerted effort by all governmental groups, including the Bureau of Mines and Mesa, should be made on improving methods of getting research information to the small operator. Actual personal contact between the person doing technical research and the Operator is desired as the conferees felt there has been a deterioration of the assistance they had normally obtained from technical representatives of supply and equipment companies in recent years. This has created a void which they think needs to be filled.

II. Standards

1. Research to determine how small and big operators alike can have input into the standard-making mechanism should be considered. Conferees had little or no understanding of how standards come about, what they could do if they disapproved of them, or how an unrealistic standard could possibly be changed.

2. Interpretation

The conferees were concerned that there was no leeway in interpretation of standards based upon local conditions present in their operations. It was felt that, while most MESA inspectors wanted to be fair, they were forced into interpreting rules literally so as not to put their jobs in jeopardy.

3. Phase out of equipment

New equipment is expensive and difficult to obtain and much of older equipment is not built in such a manner that it can fully reach new dust, noise and other standards. Research into methods of modification and extension of phase-out periods was recommended.

4. Federal vs. State Standards

There was concern that new legislation will be passed on the National level which will make stricter the already sufficient standards being met by the industry in the State of Missouri.

New changes in the rules will create more problems and increase costs with little true benafits. Dual inspection by MESA and State Mine Inspectors is unnecessary in the opinion of the attendees.

5. Unrealistic standards

The conferees felt that some standards were so ridiculous when applied to their individual operations that some method of relief should be instituted. An example given was the wearing of self-rescuers by the men in a very shallow, multiple adit entry stone outcrop mine, where the man could surely get to the surface in less time than it would take him to put on the self-rescuer.

6. Cost-Benefit studies

It was felt that no new standards should be promulgated which did not take into consideration cost-benefit studies, both from an economic and a humanistic standpoint. New standards have caused many small operators to sell out or just plain terminate operations. An example is the requirement for rigid dust-control on operations which were remote from neighbors and populated areas but on which the same standards were applied as those located in metropolitan areas.

III. Labor-Management

1. Research into incentive plans which could be used by small operators to more intimately involved their labor force in their business and increase safety and productivity is recommended.

2. During the discussion I explained the Inherently Safe Mining Systems contract presently being demonstrated in the coal

industry and the conferees suggested that a similar demonstration project be instituted to put together the best of technology for the small quarry operator.

IV. Safety and Health

1. Report procedures should be reviewed with a goal of simplification of accident report procedures and the establishment of only one report to serve all government agencies.

2. Research is recommended to determine why many Union groups fail to support safety training and programs put on by the industry and as to why individual Union members are not held more accountable by regulatory agencies when they violate safety and health rules of the company or that are covered by Federal laws.

3. Research is needed on uniformity of accident reporting to be sure that data obtained is comparable between different operations and between different industries.

4. Training program research is needed to properly equip the laborer for the jobs which confront him in the industry, especially as new technology and more productive equipment is developed. If the operators have truly trained people, they are less reluctant to pay high wages. Too often supposedly trained personnel are not truly trained in their jobs.

5. In the health area, it was felt that the mining industry in general has become a "whipping boy" in that many of the health hazards attributable to it are not necessarily present. The example given was the prevalence of lung disorders in people who smoke where the hazard from smoking far exceeds the pulmonary hazards

associated with their job in industry yet the industry is blamed.

V. Equipment

1. There was interest expressed in large hole drilling research. Equipment for small operators that would drill holes in excess of 6 inches in diameter was of particular interest. Vacuum systems for dust control were also mentioned and research into improved rotary and possibly sonic drilling systems was mentioned.

2. Standard controls for equipment was discussed and it was felt that this should be done by equipment class rather than by trying to develop overall standardized controls to fit all equipment when the functions might differ considerably.

3. Research studies into the feasibility of modifying present equipment to fit new safety standards was mentioned. Cost-benefit studies which could determine for the small operator whether it was better to modify existing equipment or to scrap it and purchase new.

4. A truly automated crusher-screen plant for the small operation should be developed. The size of this plant should be for operations near 300,000 tons per year.

5. Research into the cost benefits of new technology and particularly new equipment was felt to be an important area.

6. Studies on dust and noise control and the effects of standards upon the small operator were suggested. It was felt that too little is known about the sources of dust and a study should be conducted to determine where the true problems lie.

VI. Environment

1. Studies into the SO_2 scrubbing systems should be undertaken to ascertain the product demand which will be placed upon the limestone industry. These studies could well affect the economic viability of the limestone industry for years to come.

2. Research into sludge removal, disposal and solidification systems should be undertaken as this problem greatly affects the viability of scrubbing stack gasses.

Conclusions

The conferees in this workshop were very appreciative of the opportunity to present some of their thinking for consideration by the Bureau of Mines. To me it was striking, the contrast between frustrations which were expressed at this workshop involving small operators as compared with past workshops where only large corporations were present. If I learned any one thing, it was that these operations must be given more consideration in the future by governmental agencies or there is a great danger of a mass exodus from the American Mineral Industry of the independent small operator who fills such a vital need to supply the industrial minerals requirement of local communities. The impact of such an exodus would drive up construction costs, create shortages and all in all disrupt the economy.

If you have questions on this report, feel free to contact me for clarification.

Respectfully submitted by:

James J. Scott

James J. Scott
Principal Investigator

JJS/lrv

Appendix

Attendees

1. Ben P. Donnell, J. P. Valley Mineral Products Corporation
   St. Louis, Missouri 63101

2. Tom Regenhardt Southwest Mo. Stone Co.
   Buncombe, Illinois 62912

3. F. L. Brumback Bates County Rock-Div. of Ash Grove Cement Co.
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4. W. Ives Mining Geologist - Ash Grove Cement Co.
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   Kansas City, KS 66103

5. Calvin Thomas Carthage Marble Corp.
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   Carthage, Missouri 64836

6. Adolph G. Adrian Adrian Materials
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7. Joe Adrian Adrian Materials
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   Rolla, Missouri 65401

RESEARCH AND DEVELOPMENT PRIORITIES
FOR THE SURFACE COAL MINES
OF THE ILLINOIS BASIN

April 26, 1974

By

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U. S. Bureau of Mines
Contract No. HO242034

Introduction

This report is the third of a series reporting findings from workshops held with various segments of the Mining Industry under United States Bureau of Mines Research Contract No. HO 242034.

This meeting was held in Benton, Illinois, on April 26, 1974, at the Holiday Inn. Representatives of Amax Coal Company, and Consolidated Coal Company were present. Five other surface producers had been invited and had agreed to send representatives, but they did not attend the workshop. The names and titles of specific personnel are listed in the Section entitled Attendees.

The morning session was devoted to problem definition with each company appraising its own situation. The afternoon was used to combine together research areas of common interest and to set up a priority listing as to their importance to the company. This report covers my impressions and the priority listings as developed.

Priorities - General Rating

Eleven broad categories were developed at this workshop. They are:

1. Environment
2. Training and Manpower
3. Slope Stability
4. Equipment
5. Communications
6. Explosives Research
7. Health
8. Haul Roads
9. Federal and State Standards
10. Tranportation
11. Penalties and Laws

Each of these categories have sub-categories which will be listed and, where appropriate, comments to clarify will be added. The problems are ranked in order of importance, number 1 being rated most serious, etc.

Priorities - Specific Areas

I. Environment

1. Impact Statements

Governmental overlap and excessive paper work need to be researched and, if possible, eliminated. Public opinion is strong in this area so that obviously studies must be made but streamlining [illegible] procedures is absolutely necessary.

2. Water Discharge and Sedimentation

Due to the fact that surface operations move large volumes of material and move rapidly over the surface of the ground, construction of settlement ponds and water treatment areas and their maintenance is quite difficult. In some cases, water quality must be better leaving the strip operation than the form in which it enters it.

3. Reclamation

Reclamation studies are needed to determine the best secondary use for disturbed land. Costs of reclamation are running as high as $5,000 per acre to reclaim the land for agricultural plantings when a much lesser cost might be possible and a better dollar return for acre obtained through some other use such as pasture land, timberland or recreational use.

4. Public Relations

The public needs to be informed of the measures being taken by mining firms to prevent longlasting damage to lands disturbed by mines. The industry suffers from its own lack of credability in its public relations efforts.

5. Property Line Nuisance

When surface mining operations near property lines, problems result from equipment noise, blasting vibrations, dust, etc. Research might indicate ways in which operations might be modified near property lines to lessen the problem.

6. Dust suppression

This problem is particularly prevalent on haul roads during dry weather where large vehicles travel at high speeds and dust can be blown for considerable distances. It may also be present in land reclamation operations and in shovel or drag line operations.

II. Training and Manpower

1. Worker Responsibility

It was felt there was a need for research to determine just what portion of responsibility for their actions should be assumed by the individual worker and/or the union under the law. It was felt the companies were being unfairly penalized in cases where the hourly employee was grossly negligent. Also it felt the studies should carry over into the area of workman's compensation as well.

2. Education into Laws

It was felt research needs to be done to educate both

Management and Union personnel into the responsibilities that they have under the law and into the ever changing standards being promulgated under the law.

3. New Employees.

Standardized programs should be developed for upgrading old employees, orientating and training new employees and this includes both union and salaried personnel. In the salaried areas this particularly applies to Foremen and Technicians.

III. Slope Stability

1. Site Investigations

Research is recommended into geologic, hydrologic and soil rock properties to better design surface operations. The properties of material in situ and in the disturbed condition need to be known.

2. Equipment Selection

Often slope stability problems result when improper equipment is selected for a particular geologic setting, or where material properties are not well understood. Research might result in a better planning and selection process.

3. Sequencing of Operations

There is a need for model development to aid in determining the best sequence to use in developing a mine to assure the minimum primary and secondary handling of materials. Improper scheduling results in excessive losses due to the large capital investment in equipment and the large volumes to be removed.

IV. Equipment

1. Maintenance

Equipment is so large in surface mines that parts-handling becomes a real problem. Often men are injured trying to lift heavy parts when a small, portable hoist should be employed. Wire rope handling and changing of large cables are particularly difficult and sometimes hazardous. Lubrication is such that much of it is automatic and these systems tend to over-lubricate, causing assumulations of grease or oil which can result in unsightly slipping hazards and possible fire hazards. A total study of the complete maintenance problem is recommended.

2. The Big Equipment Problem

Just getting on the off big equipment can be a real problem. Ladders and steps are often placed on large equipment as an afterthought rather than being incorporated in the original design. Not enough thought has been placed to placement of dip-sticks, oil-fill ports or gauges. In general, access to servicing is not good.

3. Power Distribution

There is a need for ground check systems and for improved methods of electric cable handling. Much of the large equipment operates at rather high voltages which presents a unique hazard.

4. Hazardous Areas on Equipment

High platforms and the need to work in high places, when servicing high shovels and drag lines needs to be investigated.

There is also a hazard in the lower deck areas of these vehicles where men may be trapped in close quarters by fires and fumes due to the need to travel through port holes and numerous partitions.

5. Air Conditioning and Noise

Workers on large equipment are placed in cabs to shield them from noise but this necessitates the development of reliable air conditioning systems. It is not difficult to maintain an air conditioning system on a large shovel, but it is extremely difficult on crawler tractors and wheel loaders. Without air conditioning the windows of cabs are kept open and noise may be severe. The main problem seems to be in building a system which is reliable and can stand up to dust and vibration.

6. Alarms

Research is needed to determine the number, location and types of alarms which should be used. It was felt MESA has gone overboard for back-up alarms, particularly for front-end loaders which operate in both directions. Too often when the worker cannot see the need for an alarm, wires are cut so that they remain inoperative. Perhaps some work is needed to make alarms more fool-proof.

V. Communications

1. Paging Systems - Radios

Due to the spread out nature of surface coal mining, good communication is essential to safety, maintenance and productivity. Research problems exist in the area of hardward reliability and range. Often workers are alone and at considerable distance from others. This is particularly true of dozer operators on reclamation work. A less expensive communications system than those available now would be desirable.

2. Dissemmination of Information

There is need for "canned" programs for instructional purposes to educate new employees in their jobs. This is particularly true of the Union man and the first line Foreman.

3. Internal Communications

Problems exist in the internal communication between Management Units such as Engineering, Operations, Dispatchers, Top Management, etc. Research to improve techniques should be considered.

4. External Communication

Often government agencies, members of the inspectorate and mine management fail to communicate to each other exactly what they mean and in this manner, disagreements arise.

VI. Explosives Research

1. Loaded Holes

There was considerable discussion on just what constitutes a "loaded hole". Is it one with just ammonium nitrate or is it one with ammonium nitrate and prima chord, or does it necessitate that the cap be added and attached. If equipment cannot be operated near charged holes, serious scheduling problems result and productivity is lowered. Research to clear up questions is needed.

2. Safety and Interpretation of the Law

Drilling, shooting, shovels, trucks and haulage, all must operate in close proximity so that the nearness of operations presents a problem. Coal shooting is often done within a few feet of the coal shovel and during the shift. Is this safe practice?; and what cautions should be exercised. A particular problem exists when horizontal holes are used for blasting overburden as often these holes are drilled and charged from the coal previous to loading it out so that the coal shovel must operate very close to them. Research could define the unique problems associated with them.

VII. Health

1. Noise

Noise in motor rooms, mobile equipment, preparation plants and on drills can be severe and difficult to control. A thorough study is needed.

2. Dust

Dust from haul roads, drilling, rippers, loaders, shovels and drag lines and the preparation plants is such that many different solutions may be required. Research into spray on additives and chemicals are needed. Some dust control measures introduce additional hazards in that they make haul roads slippery and dangerous to traffic.

3. Gases

Large shovels and drag lines have numerous compartments built into their structures which can become traps for toxic gases which can be harmful to life. A broad study of this problem would seem warranted to determine whether or not new standards, warning devices and ventilation systems could be developed.

VIII. Haul Roads

1. Dust Problem

The dust problem here is unique enough to require separate mention. Sprinkling, chemical stabilizers are used, but none of the methods seem to be entirely adequate. The attendees felt there should be some better ways to solve this problem.

2. Structural Bearing Capacity of Roads

Coal haulers are becoming larger and larger and this has created problems in road construction to obtain a road with sufficient strength to carry the loads placed upon it. Road costs are high, along with maintenance, and some research would seem warranted.

IX. Federal and State Standards

1. Overlap and Conflicts

There is a definite overlap between Federal, State, County and City regulations, particularly in regard to land reclamation, zoning and land use. A communication problem exists between these groups and needs to be solved so the operator can proceed in an orderly manner and use long-range planning in developing his mine.

2. Uniform Interpretation

The attendees felt there was a lack of research prior to passage of laws and this resulted in unreasonable standards which in turn are given unreasonable interpretations. They felt they needed the constructive assistance of inspectors, but not their harassment.

3. Attitude Survey of Government Agencies

It was felt that the "professionalism" of the civil servant should be researched to assure that industry received the same consideration that is given the individual citizen.

X. Transportation.

1. Railway Cars and Barges.

The availability of the transport devices to get the product to market seems limited. Research into the utilization of the units available is needed as well as into ways of increasing their supply.

2. Alternative Transportation System

There is need for research into the method of getting the product from the mine to the consumer. This product may be in the end form of electricity but; is it best to ship the coal to the power plant; build a power plant at the mine; convert to gas and ship it by pipe-line, etc. This research could be classified as long range and necessary for efficient utilization of our total national resource.

XI. Penalties and Laws

1. Effectiveness of Penalties

Research needs to be done to determine whether or not penalties are serving any useful purpose. If they are not they should be eliminated; if they are they should be strengthened where necessary.

2. Alternatives to Penalties

Is there some other form of encouragement to Industry to improve its Health and Safety program other than the use of penalties? The experience in other segments of our economy should be investigated and alternative methods developed. Incentive programs for the workers is one possibility.

3. Union and Individual Worker Responsibility

Should the individual workman suffer some types of penalty under the law if he willfully violates the law? What effect might this have on the total safety record? Should the Union bear a responsibility for the actions of its members? At present "wildcat" strikes are common and worker absenteeism is high, running 15% of the labor force in some areas. Union discipline has broken down, why? These are all factors which affect the efficient management of a mining operation and they must have a detrimental affect upon health and safety. Research to solve these problems is needed.

Conclusions

While this workshop was poorly attended in terms of the number of companies represented, the people who were present had put considerable forethought to the problems of surface mining and I feel their recommendations and priorities deserve full consideration. I'm not sure that the results would have been greatly different if more companies had been represented.

If you have questions on this report, feel free to contact me for clarification.

Respectfully submitted by:

James J Scott

James J. Scott
Principal Investigator

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APPENDIX

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RESEARCH AND DEVELOPMENT PRIORITIES FOR UNDERGROUND COAL MINES ILLINOIS BASIN

April 25, 1974

by

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U. S. Bureau of Mines
Contract No. HO242034

Introduction

This report is the second of a series reporting findings from workshops held with various segments of the Mining Industry under United States Bureau of Mines Research Contract No. HO 242034.

This meeting was held in Benton, Illinois, on April 25, 1974, at the Holiday Inn. Representative of six different mining companies were present. The list of attendees is shown in the Appendix.

The morning session was devoted to problem definition with each company appraising its own situation. The afternoon was used to combine together research areas of common interest and to set a priority listing as to their importance to the company. This report covers my impressions and the priority listings as developed.

Priorities - General Rating

Two broad areas of discussion came forth from this meeting. One I have called physical problems, the other managerial. In the physical problems category, eight specific categories were developed:

1. Ventilation and dust control
2. Ground control
3. Education and Training
4. Industrial equipment
5. Standards in Laws - State vs Federal
6. Man-Machine Relationships
7. Extraction Problems
8. Sulphur

In the Managerial area there were six categories:

1. Shortage of technical personnel
2. Union problems
3. Need for economic studies
4. Productivity
5. Communication
6. Women in the Industry

Each of these categories have sub-categories which will be listed and, where appropriate, comments to clarify will be added. The problems are ranked in order of importance, number 1 being rated most serious, etc.

Priorities - Specific Areas - Physical Problems

I. Ventilation and Dust Control

1. The development of an adequate face ventilation system is a most critical problem in Illinois. The system must coordinate continuous miners, tubing, fans, scrubbers, brattice lines, etc. to eliminate recirculation, dilute methane, and clear out dust. Due to the ground conditions in Illinois, headings cannot be made very wide, with 14 to 16 foot headings common. This restricts the room available and limits flexibility. Many of the operators in the district, the particularly Old Ben Coal Co., would like to use boring machines, but these have been virtually eliminated because of ventilation requirements. In some cases, a double-brattice system has had to be used to put a separate air-split over electrical equipment. This has added greatly to the amount of air put into the mine.

2. Accurate dust samplers are needed.

In company tests, it has been indicated that samplers can show errors of plus or minus 14%. It was felt that better samplers could be developed. The MESA computor print-out from data collected by inaccurate samplers, was seriously questioned as to its validity. Recent data published by MESA indicating 92% of the coal mining section in the United States being in compliance was not considered valid by the attendees.

3. Stoppings.

There is need for developing new methods and materials for placing permanent stoppings. Masonry walls require too much labor and are too costly. Interest was expressed in U. S. Gypsum's plasterboard gypsum stopping as it appears to solve many problems.

4. Borer vs conventional continuous miner.

The arch section cut by borers is particularly useful in Illinois as it serves to improve ground conditions. But, as stated previously, due to the small, restrictive entry cut, ventilation is difficult. Research into a machine which would cut this section but still allow room for ventilation should be considered.

5. Bleeders and abandoned areas.

Research is needed as to the best technique relative to abandoned areas, when the mine is still operating in close proximity. Should these areas be sealed with explosion-proof bulkheads or should they be constantly ventilated? There was no unanimity of agreement.

6. Standards in the Law - State vs Federal

Conflicts exist between the State of Illinois and MESA as to how mines should be inspected and many technical procedures carried out. An example is the State requirement for a safety lamp and the Federal requirement for a methane monitor. A thorough study should be made of conflict areas and then mediation meetings held to resolve differences.

7. Number of entries.

Due to the need for large volumes of air, the number of entries driven has increased approximately 70%. For example, where seven entries have been used in the past, thirteen are used today. Research to reduce the number of entries is needed.

8. Safety Lamp.

It was felt that some research could be done upon the tried and proven safety lamp to make it possible to read low methane ranges, say down to 0.1 percent methane. The device might possibly be a combination between the plain safety lamp and electronic methane detector.

II. Ground Control

1. Roof bolts - quality control.

Despite the fact that millions of standard roof bolts are used per year in the United States, quality control upon installation is still poor. Research to improve installed quality is needed.

2. Resin bolting.

MESA is requiring more and more expensive resin bolts to be used in Illinois coal mines. These installations are approximately two times as costly as standard bolts. Research is needed to determine just when resin bolts are needed in lieu of standard bolts and also to assure quality control of resin installation.

3. Cabs and canopies.

Rational designs have not been fully developed and more engineering work is needed. There is still some resistance by the men to using them when they cramp them or limit their maneuverability.

4. Continuous support with the miner.

There is a need to make the continuous miner truly continuous. To do this, support systems must be developed which travel with the miner and continuously support the back as it is exposed.

5. Pre-mining information.

It was felt mines could be better planned and support systems more rationally laid out if more information could be obtained from drill cores and remote sensing techniques before the actual mining took place.

6. Sealants.

Sealants are needed to prevent atmospheric deterioration of shales. It needs to be flexible and adhere readily to the back so that ground movements will not dislodge it. Fiber impregnated sealants were suggested to increase their durability.

7. Remote control.

It was felt much more could be done in this area to remove the man from the hazardous area when placing ground support. This was particularly true with resin bolting where the man must expose himself to place resin cartridges and also in installing the rebar.

8. Roof control specialists - MESA.

The attendees felt that MESA's past program of sending roof control specialists into the mines in a concerted program to help the operator was most beneficial. This program is not being followed up in at least Illinois, and it was felt research to assess the effectiveness of the roof control specialists could result in a reactivation of this program.

9. Support design for permanency.

Artificial ground support system should be worked out which will last for the entire desired life of the entry. Repair costs are often more costly than initial support costs. Savings can result if the support is designed to last for a specific time period.

10. Roof bolt recovery.

Due to the shortage of steel and roof bolts, it was felt some research on the advisability of recovery of roof bolts from worked out areas was needed. A remotely controlled machine is recommended.

11. Back filling systems.

This is a long range project, but it was felt that back filling could increase extraction, prevent subsidence, and get rid of undesirable waste from other parts of the operation.

III. Education and Training

1. Front line foreman training.

There is a great shortage of front-line foremen and research to set up the proper curriculums, course outlines, visual aids, etc. to develop a standard quality is needed.

2. Motivational research.

There is need for research to motivate the union man in Health and Safety, in productivity, pride in job, etc. This is true in old employees as well as new.

3. New employees.

Research to determine the aptitude of new employees and their suitability for certain jobs would be most helpful in getting them started on the right course.

4. Re-training and upgrading.

Continuous education programs are needed. In this manner employees can be upgraded and, after a certain period of time, follow up programs can be instituted.

5. Standardized training.

Research into canned programs which could assure that every miner in the United States in certain jobs would at least be assured of certain essential preparation for his work. Audiovisual aids were stressed in this area.

6. Communication skills.

Better communication in all directions is needed. Not only between the foreman and the worker, but between workers, from the worker to his union, union to management and vice versa, and within the various levels of management.

7. Employer-community relationship.

Research to show companies how good community relations can help them is needed. Mines have been stereotyped as dirty, dusty, noisy, hazardous places to work, and this image needs to be changed.

8. Employee-family-community studies.

Employee performance on the job is greatly affected by his place in the community. Some research should be done to determine how much this might influence his ability to be a safe, productive worker.

IV. Industrial Equipment

1. Permissable electrical equipment.

Due to the great number of things that can go wrong with complex mining machinery, there is a great need for continuing research into permissiblity. Inspectors particularly pick upon safety covers, air gaps, etc. in writing citations against operators. Under this point and all others under this section, a preventative maintenance program is absolutely essential.

2. Fire suppression and fire warning systems.

Belts, continuous miners, mobile and stationary equipment all present such a variety of fire hazards that a continuing program of research is needed. Also, training programs should be developed to assure that all systems are kept operative.

3. Alternative power sources.

Work is recommended on diesel, battery and any other alternative power methods, to develop maximum flexibility and utility of equipment.

4. Transportation.

New materials-handling systems need to be developed both for material into the mine and out of the mine. The problem of getting personnel to the working face and the lost time involved was discussed. Research on mobil belt systems, hydraulic transports and pneumatic transports is needed.

5. Equipment design for safety, productivity and maintenance

These three factors are so inter-related that anything done in one area automatically affects the others.

6. Noise and lighting.

It was anticipated that regulations in these areas would become more severe and research is desirable.

7. Communication systems.

There is a need for more work on mine network communication systems to assure dependability and to be able to reach all personnel quickly in case of emergency.

V. Standards and the Law - State vs Federal

1. Review the technical feasiblity for such items as ventilation, bratticing, explosive delays, etc.
2. Research interpretation of the act and flexability to be allowed for the District Managers of MESA to make interpretive decisions based upon conditions in their particular district.

3. Research how standards can be changed.

As mining technology changes, standards will need to be changed and a rational, logical procedure needs to be developed.

4. Research to coordinate and match State and Federal regulations.

VI. Man-Machines.

1. Standardized control.

As nearly as possible, all machines should have similar controls with similar movements incorporated in them.

2. Remote control.

Wherever feasible, remote controls to remove the man from the hazardous area, should be used.

3. Safety should be designed and built into all equipment.

4. Design equipment to fit the man.

5. Visability problems.

Position of the man of the equipment often limits his visability and many times his cap lamp is a poor source of illumination.

6. Canopies for low coal.

More work needs to be done on this problem to assure that canopies don't create more problems than they solve.

VII. Extraction Problems.

1. Research to improve extraction.

Currently many mines in Illinois only mine 42% of the total coal in place. This is a tremendous waste of natural resource and research on the problem is needed.

2. New Mining layouts of systems.

It was felt that new conceptual approaches should be tried and that we should not always try to use the same technique over and over with only slight improvements upon it.

3. Fill systems.

Fill mining systems may be combined with waste disposal systems to solve two problems simultaneously. Disposal of surface waste and the increased extraction from mining.

4. Subsidence research.

Research to control subsidence, as well as to prevent it is needed. It was felt that higher extractions, by whatever system used, will probably be accompanied by some subsidence problems. Therefore, research is justified.

VIII. Sulfur.

Due to the fact that most Illinois coal is high sulfur, the attendees felt there was a need to stress that research should be continued into the power plant burning problem, stack gas scrubbing problem, and synthetic processes, such as liquification and gasification.

Priorities - Specific Areas - Managerial

I. Shortage of Technical Personnel

Lack of leadership and overtaxed management and technical personnel is a major concern to the industry. There is a great shortage of mining, mechanical and electrical engineers. It was felt that there was a place for an associate degree to give special training in specific areas. It was not felt that there was an extreme shortage of geologists or environmentalist types. In short, what is needed is research into techniques and methods of getting people interested in working on the tough operational problems of mining.

II. Unions

Research is needed to determine why discipline has broken down in Unions. Wildcat strikes are rampant and legal aspects of contracts need to be studied. Unexcused absenses in many coal operations are running at 15% of the daily labor force. Research into incentive systems and also penalty systems is needed. Study of the entire Union-Management relationship is needed. What are the Union's motives? Perhaps a study of Management's reactions to Union procedures would cast light upon these problems.

III. Economic Studies.

Research on the impact of government upon industry through its great power as the regulating agency should be studied. The true dollar cost to the Republic should be made clear, especially in the case of envirionmental matters. Economic impact research into the true cost of Workman's Compensation is also vitally needed.

IV. Productivity Research

Research is recommended into simulation studies, longwalling, and totally integrated systems where the maximum of automation may be employed.

V. Communication

It was recommended that Management seminars be developed to inform industry of the government's plans and to inform Government of the industry's plans.

VI. Women

Research to study the special management problems and types of facilities that would be required to bring women into the Mining Industry should be considered. Research to determine what impact this would have should also be undertaken.

Conclusions

The attendees of this workshop are to be commended for their preparation, frankness and constructive suggestions toward a research and development program which can meet the needs of Illinois Basin coal mining. If, after reading this report, you have questions, please feel free to contact me for clarification.

Respectfully submitted by:

James J. Scott

James J. Scott, Professor of
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JJS/lrv

APPENDIX

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RESEARCH AND DEVELOPMENT PRIORITIES FOR THE NEW LEAD BELT MINES OF MISSOURI

March 1, 1974

By

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U. S. Bureau of Mines
Contract No. HO242034

Introduction

This report is the first of a series reporting findings from workshops held with various segments of the Mining Industry under United States Bureau of Mines Research Contract No. HO 242034.

The first meeting was held in Salem, Missouri, on March 1, 1974, at the Tower Inn Hotel. Representatives from the four producing companies; St. Joe Minerals, Amax Lead Company, Cominco American, and Ozark Lead Company were present. The names and titles of specific personnel are listed in the Section entitled Attendees.

The morning session was devoted to problem definition with each company appraising its own situation. The afternoon was used to combine together research areas of common interest and to set a priority listing as to their importance to the company. This report covers my impressions and the priority listings as developed.

Priorities - General Rating

Two broad areas of discussion came forth from this meeting. One I have called Technical; the other Managerial. In the Technical area, seven categories were developed. They are:

1. Ground Control
2. Mining Environment
3. Surface Environment
4. Rock Fragmentation

5. Materials Handling
6. Technical Communication
7. Miscellaneous

In the Managerial area there were two categories:

1. Legislative Research
2. Education and Training

Each of these categories have sub-categories which will be listed and, where appropriate, comments to clarify will be added. The problems are ranked in order of importance, number 1 being rated most serious, etc.

Priorities - Specific Areas - Technical

I. Ground Control

1. Detection and protection from high back loose ground.

The New Lead Belt has extremely thick ore bodies in certain areas, with some zones exceeding the reach of the highest scaling rigs now on the market. Detection of what is loose is also a major problem because of its inaccessibility.

2. Rock Bolting Research

The how and why of rock bolt usage is not understood by the Foreman, and thus the decision as to where and when to place bolts is made without adequate knowledge.

3. Remote Monitoring Instrumentation to Assess Ground Conditions

This ties in with point No. 1, but could also relate to brecciated ground, slabbing pillars, etc.

4. Rock Bolt Testing

Cement grout bolts are being used as well as resin bolts and standard bolts. Better testing techniques are needed for all installations. Mechanization and remote installation should also be investigated. Where cement bolts were used in the back, it is difficult to keep the cement in the hole until the reinforcing bar can be installed. Due to the lower cost of cement, as opposed to resin, there is great interest in research in this area.

5. Geologic Ground Control Studies

Not all backs in all mines are rock bolted. There was discussion on the need to research geologic factors such as: bedding thickness, strength, interfaces between rock and shale, brecciated ground, fracture zones etc. Too often dangerous ground conditions are not recognized until a portion of the back has fallen.

6. Back Filling

It was felt that as mines are completed, there will be a need to fill some areas. Since Cominco America's Magmont Mine has only limited reserves, they will probably be the company most interested in this research in the near future, but all mines will be interested in it as they approach completion.

II. Mining Environment

1. Long Term Effects of Diesel Fumes upon the Human Respiratory System

These metal companies do not want to experience anything like the Black Lung experience of coal companies. For this reason they feel the long term physiological effects on humans in an atmosphere containing diesel fumes should be studied. It was felt that there are a sufficient number of individual miners in the industry who have worked on diesel equipment for a number of years, that a good statistical study could be made of their lung conditions to determine if a problem exists. This, of course, might be followed by corrective action.

2. Air Quality at the Working Place

The general consensus was that standards should be based upon air quality rather than air quantity in the area surrounding the workman.

3. Ventilation Studies for Large Mine Openings

The openings at the New Lead Belt in some cases are so large that it is impossible to make meaningful velocity measurements. There is a fear that ventilation studies developed in restricted, high velocity, high pressure mine openings will be applied to these large openings and form new standards which will be impossible for the companies to comply with. Model studies are recommended.

4. Refuge Chambers

MESA has insisted that refuge chambers be used underground in the New Lead Belt to provide protection for workmen in case of underground fire. Some chambers have been constructed by local ironworks or sheet metal operators, and it is very questionable that the engineering on these chambers was adequate.

Standards should be developed for the chambers and studies made to determine the time which men would have to stay in them in case of a disaster.

5. Noise Research

Hydraulic drills should be investigated, as several companies are planning to go to all hydraulic drill systems in the near future.

6. Illumination

7. Communication Systems

It would appear to me that John Murphy's paging system might have good applicability in the New Lead Belt, in part due to the large size of the openings.

III. Surface Environment

1. Development of Standards

It was felt that many standards have been placed upon the industry with little or no documentation to support the numbers placed in the standard. Research should be done to scientifically determine unsafe levels.

2. Heavy Metal Ions in Mill Discharge - What to Do

The Operators recognize that they have a heavy metal ion problem, but at this point, no research has really been done on what can be done to remove the ions from the effluent. A removal system should be researched.

IV. Rock Fragmentation

1. Charging Systems

The charging system is out of balance with drilling and mucking capability. There is a need for research to mechanize charging to reduce time and manpower requirements.

2. Slurry Research

New blasting agents are constantly being placed on the market and more research is needed to determine the advisability of using them.

3. Large Blast Hole Drilling and its Effect on Pillars

In benching operations, large diameter blast holes, up to 6 and 7 inch diameter, could conceivably be used, but there is considerable concern for the effect this would have on pillar stability.

4. Storage Regulations for Blasting Agents

There seems to be a problem in determining the standards that should be applied to blasting agents storage both underground and at the surface.

5. Continuous Mining Machines

It was felt that there was a need for a continuous miner, perhaps not of the classic tunnel borer type that cuts a round section and is not flexible or versatile, but rather a machine which could cope with the irregularities of mineralized deposits and eliminate the cyclic aspects of drill-blast mining.

V. Materials Handling

1. Breaking Systems

There was common agreement that presently designed breaking equipment of underground equipment was difficult to maintain and there is need to improve them.

2. Tire Research

Tire cost is a major component of overall mining costs in the mechanized diesel powered systems used in the New Lead Belt. No one at this work shop knew of any tire research being carried on to work specifically on the problems found underground.

VI. Technical Communications

1. The Bureau of Mines should research standards in proposed legislation prior to passage of legislation. There was common agreement among the conferees that past legislative practices have resulted in unrealistic standards which are costly to the industry, do nothing to improve safety, and are extremely difficult to change once they are passed.

2. Safety standards should be examined to assess their needs.

Too often standards have been passed that at first seem good but, in actuality, a need for the standard did not exist.

3. Research to aid both company and government inspectors to develop uniformity in inspection procedures.

4. Research to determine a method of prompt assembly and dissemination of research and development findings.

VII. Miscellaneous

1. Improved mine design and equipment

It was felt that the Bureau could serve as a good agency to look at entirely new concepts of Mineral extraction. In essence, some "Blue Sky" research is needed and is desirable.

2. Tailings Dam Construction Research

Priorities - Specific Areas - Managerial

I. Legislative Research

I had great difficulty keeping the attendees off the subject of their communications problems with government agencies in regard to regulations. They felt there was a great need for thorough study of the practical and economical implications of standards as well as the safety implications. There was inference that the government needs a better clearing house or method for informing operators of its thinking. The American Mining Congress is not an effective vehicle.

II. Education and Training

1. Upgrading and qualification on a technical vocational basis.

The companies felt that they cannot justify the cost of training great numbers of diesel and hydraulic mechanics who, upon completion of training, leave the mines to go to the St. Louis area for higher paying positions. They feel the government should research the problem to determine whether or not government sponsored upgrading should not be considered. As all hydraulic drill jumbos come into existence, problems in this area will worsen.

2. Motivational Studies

3. Hazard Recognition Training

Because of the nature of mining, research needs to be done to determine the best techniques so that miners themselves immediately recognize hazards when and where they exist.

Conclusion

It is the author's opinion that this first meeting under this research grant was a success. A priority listing was developed and comments by the attendees indicated they felt their time was well spent. It, at times, was difficult to keep discussion zeroed in on projects that had research and development possibilities, but all in all a good technical discussion was obtained.

After you have studied this initial report under this research grant I hope you will communicate to me its strengths and weaknesses as you view it.

Respectfully submitted by:
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Professor James J. Scott
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JJS/lrv